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THE KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY.

EDITED BY

THEO. S. CASE.

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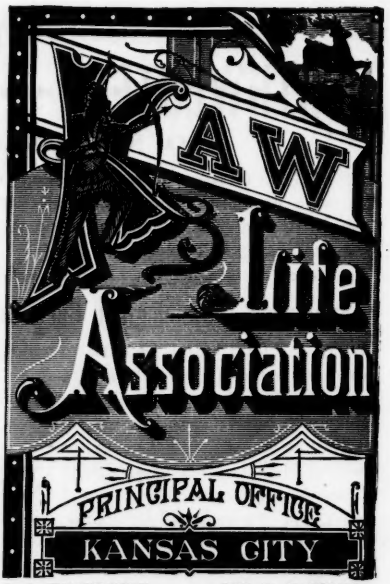

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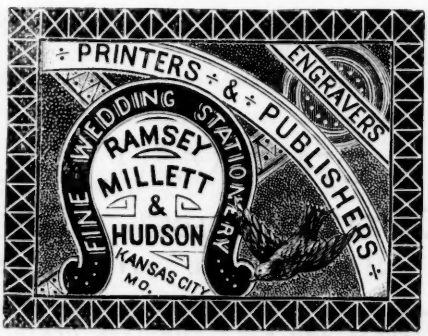

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REVIEW OF SCIENCE AND INDUSTRY,

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VOL. VII. JANUARY, 1884. NO. 9.

PROCEEDINGS OF SOCIETIES.

THE SEWERAGE OF KANSAS CITY.[1]

O. CHANUTE, C. E.

The importance of the selection of an adequate system of sewerage and drainage upon the health and fortunes of a city, cannot well be overestimated. Not only does it involve the expenditure of vast sums of money, but more precious still, the welfare and health of the citizens depend upon the wisdom of the selection, and errors once committed are, if not impossible, at least very difficult to correct. Indeed, the more the subject is considered the more its importance grows upon the mind of those who, like the audience that I now see before me, are interested in the prosperity of the city. I therefore hope that what I have to say shall be critically received, so that whatever is sound may result in good, and whatever may be erroneous shall be eliminated.

Nearly two years ago, upon a very brief visit to Kansas City, and before I had come back to reside among you, I became aware that it was proposed to adopt what is known as the "combined system" of sewerage. I thought that this would prove to be a mistake, and feeling a great interest in the welfare of the city, I asked a few citizens and the reporters of the public press to meet me one evening, when I laid before them chiefly what others had said upon the subject of sewerage, and upon the dangers to health of an improper selection. I endeavored to point out that not only would the "combined system," so called, be

1 Read before the Kansas City Academy of Science, Friday evening, November 30, 1883.

very much more expensive than what is known as the "separate system," but that if we judged by the experience in other cities, it would also largely increase what physicians call "zymotic" diseases, such as typhoid, diphtheria, scarlet fever, etc., a class of diseases from which Kansas City had hitherto been happily remarkably free, and which are supposed to be produced by imperfect ventilation and drainage, and especially by the exhalations of large sewers.

At that time there were, if I remember rightly about four and a half miles of sewers in the city, while at the present time there must be over twenty miles, so that enough has been done in the meantime to give us some data by which to form a judgment as to the soundness of the reasoning which was then advanced, and if we distrust the experience of others, at least to give us some experience of our own.

Since my return to Kansas City I have been endeavoring to inform myself as to what the facts really are, and I find that there is a general impression that the city is not as healthy as it was in the early days of its history. I have been informed by some of the leading physicians, that there has been an increase in zymotic diseases (the much dreaded scarlet fever, typho-malaria and diptheria), and that they show a marked difference in type from the same diseases as they existed in the days before sewers; but that in few cases only have they been traced directly to the effect of the sewers, or to defective plumbing. Other physicians again, while admitting an increase in zymotic diseases, attribute it to the increase of population, or to the turning up of the soil while carrying on public improvements in various parts of the city.

As vital statistics have been kept here much too short a time to permit of any comparisons being made, or to form the basis for an actual demonstration of the effects of the sewers, I must abstain now from making a positive statement upon this branch of the subject, but I hope that the physicians of the city, who, both from their experience and scientific training, are the persons best fitted to reach sound conclusions on this subject, will favor us with their opinions, and with the actual facts occurring within their knowledge.

Upon one point, however, I believe all persons are agreed, and that is, that with a separate system of sewers in which the house refuse shall be confined by itself in small pipes, daily flushed for their whole length by automatic means, there would be no chance for the development of the so-called sewer gas, and no danger of infection from that source. All believe, therefore, that whether the "combined system" is really as dangerous as has been represented by sanitarians elsewhere or not, the "separate system" would certainly be safer.

This brings us to consider in what respects these two systems differ from each other, and why the one should be thought to be unhealthy, while the other is admitted to be safe. Some persons seem to have an idea that the subject is intricate and mysterious; that the two systems differ in the same way as do two complicated designs for different purposes, or two plans for some intricate machine. In point of fact, however, no subject is simpler or more easily understood, and the only difference in principle between the two systems, is that in

the "combined system" the water, which comes from the occasional rains, the "storm-water," so called, is admitted into the sewers, along with the house refuse, while in the "separate system" the house refuse alone is carried away by one set of pipes (which are daily flushed), while the "storm-water" is carried away partly in open gutters, and partly (whenever it accumulates to such an extent as to cause annoyance) by another set of underground sewers.

This is all the difference there is in principle between the two systems, but this difference, simple as it is, involves several important consequences.

The first is that the large sewers, in the combined plan, have to be carried along of the full great size required by the storm-waters, under every portion of the district to be drained, instead of being confined as in the separate system, to those short sections where the "storm-water" accumulates enough as to prove objectionable. It will readily be understood that this will largely add to the expense; for once the "storm-water" and house refuse are mixed together in a sewer, we no longer dare to admit them to the light of day, until they are clear of human habitations.

The second consequence is that the combined sewers must be made large enough to pass at the same time both the "storm-water" and the daily sewage, and the further consequence is that during at least nine-tenths of the time (for I do not suppose that in this climate it rains anything like one tenth of the time) the sewers are not more than one-twentieth full, while on the other hand they are not unfrequently overtaxed during the remaining one-tenth of the time, by our semi tropical rains.

It may be questioned here in passing, whether the peculiarities of the climate of Kansas City have been taken sufficiently into account, in carrying out the system of combined sewers. They are proportioned as I understand it, upon the rule of allowing for a rainfall upon the drained district, at the rate of one inch per hour. This is an English rule, and a very proper one in that climate, where it rains nearly every day, but seldom violently. Here, where for weeks and perhaps months, we sometimes do not get a drop of rain, and where, when it does come, it sometimes pours down three or even four inches in an hour, sewers proportioned by the English rule may prove both too large and too small—too small to carry off the occasional semi-tropical shower, and too large, much too large, to be properly ventilated through the openings which it is practicable to make.

The result necessarily must be that during at least nine-tenths of the time, the Kansas City sewers will be nineteen-twentieths full of noxious gases, which physicians tell us are dangerous to life. We may, perhaps, keep these gases out of our houses by perfect plumbing, but to me it seems far wiser to prevent their production, by breaking away from tradition and adopting what I consider as a more appropriate and rational system of sewerage for this city.

It must however be admitted, that at first consideration the combined system of sewers seems a perfectly plain, obvious and sensible method to adopt. There is a certain amount of house refuse or sewage and a certain amount of

storm-water to be carried off, and what can be more obvious than to provide one single sewer to do it all. We have been laughing for a good many years at the Pennsylvania Dutchman who cut two holes in his barn door, one for the cat and the other for the kitten, and we may fancy that we would be equally the objects of ridicule if we were to imitate his conduct in planning our sewers.

I hold, however, for myself, that the Dutchman was right in cutting the two holes, if it was necessary that the cat and kitten should go into the barn at the same time, and that is precisely what occurs when we have a rain storm. The storm-water has to be taken care of, and the house sewage has to pass through the sewers at the same time.

Moreover the combined system has all the weight of precedent and all the prestige of great antiquity. It is more than 2,000 years since men have been building sewers, and it is natural that when modern engineers tell us that the storm-water and house refuse should be separated, we should hesitate to innovate upon what we suppose to be a venerable practice, sanctioned by the experience of so many centuries.

I confess that in my own case, when the subject first came to my notice, some three years ago, I questioned seriously whether the proposition did not contain somewhere a fallacy—whether in course of time some hidden defect would not be discovered in the separate system which would result in its abandonment.

In point of fact, however, we are not now using our sewers as did our ancestors, and the combined system is really of modern origin. Sewers were originally built for storm-water alone, at those points where it became a nuisance, and what we now consider as sewage proper went into cesspools, to be periodically removed by hand. In England it was illegal to use the sewers for household purposes up to 1815, and it was only in 1847 that the latter use was made compulsory. The result of this combination has been so unsatisfactory that the English sanitarians and engineers have been experimenting with all sorts of devices to obviate or mitigate the evils thus created. In France it is still the rule that sewers shall serve for storm-waters alone, and a distinguished French engineer, M. Lavoinne, in giving recently an account of the Memphis systems of sewers, says: "It is to be noted that the system which we have described, is precisely the reverse of that which is generally practiced in France, where the principal office of the sewers is to carry off storm-waters, and where they are made large enough to be traversed by the workmen who are to clean them. Moreover, in Memphis the system is connected with all the house closets, the solid product of which is generally with us excluded from the sewers."

This matter has created a great deal of interest in France, and to give a better idea of the positions taken by French engineers, I will read the following translation of Engineer Lavoinne's conclusion upon the subject, to wit: "The immediate disposal of all excreta, whether liquid or solid, coming from dwelling houses, is evidently the best method of guarding against danger, from a sanitarian view. If their disposal is made through a sewer of sufficient section to pass both

these excreta and the storm-waters, it will be subject to all the variations which may result from the intermittency of the storm-water, which will generally run too slowly to carry away the solid matters, unless indeed a sufficient volume of water can be artificially obtained to flush the sewers or even to provide a constant subterranean current of water, more or less clean.

"The establishment of a special outlet for the offensive matters alone, the volume of which varies but little, in order to insure their speedy disposal under conditions peculiarly appropriate to their volume and nature, not only possesses the advantage of much better satisfying the demands of sanitation, but it admits of a much better use of flushing waters, by avoiding the admixture of a portion of water, which is often unnecessary, and which sometimes has to be carried away a considerable distance at great cost in get rid of it, solely because it has been contaminated by sewer-water.

"In the large sewers of our most populous towns, and in which the water-supply pipes are generally attached, the insertion of other pipes, for the purpose of carrying sewage alone, and communicating by branches with dwelling houses, seems a satisfactory solution, in consequnce of the small sizes required, of the problem of the drainage of cesspools, which it is still dreaded in France, notwithstanding the examples of neighboring countries, to connect with the public sewers. The expense of the special pipes to be introduced into the houses would be more than offset by the expense of periodically cleaning the cesspools, frequently to the detriment of the public health; and by the elimination of the permanent dangers of infection, which the decomposition of the decayed matter presents."

Living as we do in a new country, we do not realize how modern, (nor how great, comparatively), are the conveniences which surround us in our houses. Nor do we realize how these conveniences affect the plans which were found sufficient by our ancestors. For instance, in a treatise on hydraulic engineering, published in 1858 by an English engineer, I find it stated that it was but a few years since the supply of water to private consumers was effected in all countries upon what is called the intermittent system, and that the constant, "high pressure" system, which is the only one we know in this country. was considered as an innovation which was not free from objection, on account of the resulting waste.

Now it is doubtless a great convenience, one with which we would not part for any consideration in this country, to put water on tap in nearly every room of our modern houses, but it results in cutting an equal number of openings to the sewer; and every stationary wash-bowl, bath or closet opens the way for the entrance of sewer gas: while the men who less than a century ago combined storm-water and domestic refuse in the same sewers, had one, or at most two such opening to guard in their houses, and in the majority of cases none at all, as the water was drawn from some hydrant in the yard, and the slops emptied by hand in some out-door sink.

It is evident that these multiplied openings to the sewers must prove increased sources of danger if gases are allowed to be generated, and that when storm-

waters are admitted to the sewers, the hydraulic ram resulting from a flood, must produce pressure in the sewers, and drive the gas into the houses. These difficulties and dangers connected with a combined system of sewerage seems to have been recognized in England soon after their introduction, which, as already stated, dates from about 1815, for in in 1842 Mr. Edwin Chadwick, an eminent sanitarian, proposed and advocated a separate system of sewerage which has since been supported by many eminent engineers, upon sanitary grounds. This separate system has been successfully introduced in several English towns, and that it has not been more rapidly adopted is probably due to one imperfection in the system as carried out in England, which results from the introduction into those sewers which carry off household waste of a part of the storm-waters, that which falls upon the roofs and yards, (while that which falls upon the streets is rigidly excluded) for the purpose of flushing and cleaning the sewers.

It was reserved to an American sanitary engineer, Mr. Geo. E. Waring, Jr., to finally perfect this separate system of sewerage, by excluding all of the storm-water, which latter cannot be relied upon to flush the sewers regularly, and substituting therefor an automatic flush tank, which, filling itself slowly by a spigot from the water supply, discharges itself suddenly and flushes the sewers once or twice in twenty-four hours, as may be desired.

I will not take up your time with a description of the separate system, to which the name of Mr. Waring has been justly attached. This description has been so often given by the public prints that you must all be familiar with it; but I will say that as carried out at Memphis by Mr. Waring, it is less a new invention (about the permanent efficacy of which there might then be some question) than an outgrowth and combination, made with great good judgment, of several excellent features that had been previously tried and been successful.

Many of you have very recently been in Memphis, and while there you doubtless inquired into the working of its system of sewerage. It seems to be the universal opinion that the system there is a perfect success, that it accomplishes every object that was aimed at, and has transformed this fever-plagued spot into a healthy city; while four years of constant use have not developed a single hidden fallacy in the system, or marred the unanimous satisfaction of the citizens; and this, as I am informed, in spite of the fact, that (contrary to the general belief on the subject) much of the work was originally hurriedly and imperfectly done, so that it ought to show all the defects which generally result from bad workmanship.

The general result so far as ascertained, therefore, is that the separate system at Memphis is a complete success, that it has not failed in any particular to accomplish all necessary purposes, and that it is giving very general satisfaction to the citizens.

Ask yourselves now the question, whether the citizens of Kansas City are equally well satisfied with the results of the combined system? I am afraid from the answers which I have received in private that such is not the case.

And yet, as it seems to me, no city is so well adapted as Kansas City to the

successful introduction of the separate system. The grades are steep and the slopes are short, so that storm-water can be quickly and cheaply gotten rid of by open gutters, combined with a few storm sewers; and in our climate the rains are needed to wash the streets. We have a light dry soil, admirably drained naturally, so that one of the three offices which are performed by the combined sewers, that of draining the adjoining soil of water (at the expense of occasionally polluting it with sewage) through the crevices in the work, will not be required, or if required, will be better done by laying tile drains in wet places, along with the sewers proper, as was done in Memphis. So that every consideration of expediency, of health and of economy points to the adoption of the separate system for those parts of Kansas City which are yet unprovided with sewers.

There are also special reasons why the separate system is the best adapted to the needs of this city. In a rapidly growing town, where we are dilligently building up and digging down, where the streets are being constantly disturbed, and where we have the hurly burly which so astonished our late Mexican visitors, it is almost impossible to prevent the intrusion into sewers, to which storm-water has access, of all sorts of debris and incongruous materials, which are pretty sure to obstruct the sewers, if not to choke them. If there are, therefore, anywhere good reasons for making strorm-water sewers large enough for men to go into them to clean them, (and as we have seen, this is the French practice,) certainly those reasons exist in Kansas City.

Moreover, the combined system of sewers can be scarcely carried out much in advance of the grading of the streets, and of their paving and guttering. Otherwise they would probably become useless in consequence of the changes of grades, which are not altogether unknown here, or choked by the bringing in of earth and rubbish from the unpaved streets; while, if we adopt the separate system, it can, by being placed in the alleys, be at once carried out in advance of grading the streets, in all parts of the town where sanitary reasons exist for them.

Now, let us see what will be the financial results. I have only at hand the data furnished in the report of the city engineer for the year ending December 31, 1882. From this it appears that the total area of the city is 2,907 acres, of which 200 acres had been fully sewered, and 223 acres more partly sewered, at a total cost of $314,914. If we assume this sewered portion to represent an area of 307 acres (and this cannot be far wrong), the cost has therefore been at the rate of $1,026 per acre; and if the combined system continues to be carried out, at the same relative cost, the total expenditure will be:

Cost of 307 acres sewered December 31, 1882	$ 314,914
Cost of 2,600 acres to be sewered at $1,026	2,667,600
Total	$2,982,514

I understand, however, that in consequence of good management and close economy on the part of the city engineer, the cost has been largely reduced from that of previous years, and he estimates that in the parts of the city not already

laid off in districts, the cost will not greatly exceed $1.50 per 100 square feet, or $653.40 per acre. We must therefore revise the calculations previously made, and in order to make sure that we shall get a minimum estimate, we will assume that the whole of the 2,600 acres remaining to be sewered, some of which of course is included in existing districts, shall be completed at the above estimated cost of $653.40 per acre. The revised estimate will then stand thus:

Cost of 307 acres sewered December 31, 1882 . . .	$ 314,914
Cost of 2,600 acres to be sewered, $653.40	1,698,840
Total	$2,013,754

It, therefore, appears probable that the cost of the present system of sewers, if extended to the whole area of the city, will be between $2,000,000 and $3,000,000. This brings us to the inquiry as to what will be the cost if we should adopt the separate system for these portions of the city yet unprovided with sewers. The cost in Leavenworth is stated to be, as near as possible fifty cents per 100 square feet, or $217,80 per acre. If we assume these figures as correct, we have the following estimate:

Cost of 307 acres sewered December 31, 1882	$ 314,914
Work done during 1883, say 100 acres at $700	70,000
Cost of 2,500 acres to be sewered at $217.80.	544,500
Cost of storm-water sewers to be built hereafter. . . .	150,000
Total	$1,079,414

So we may say, in round numbers, that it is yet possible to save a million of dollars to the city, by adopting the separate system of sewerage for the portions not yet undertaken.

It will be noticed that in the foregoing estimate the sum of $150,000 is allowed for storm-water sewers, to be built at points where the accumulation from the gutters proves to be a nuisance. I do not believe that there will be many such points. In Memphis there are said to be none at all; but even if we have to double or treble that estimate, we shall still realize a notable economy over the cost of completing the present system.

Let us even assume the very worst possible supposition, one which is nearly impossible, that the storm-water shall prove in time such a nuisance, over all parts of the city, that we shall be led to underlay every portion of its site with another set of sewers for storm-water alone. It will certainly be admitted that this contingency is remote, that it will not occur for many years, and I will ask whether it is not better, even in that event, to construct now a set of cheap sewers for sanitary objects alone, even if we have hereafter to encounter the full cost of another set to provide for storm-water alone, which, be it remembered, may wet the feet of passengers, render crossings impracticable for a short time, or even occasionally tear up gutters, or flood a cellar; but which cannot endanger health or life, as we are led to believe by sanitarians the combined sewers do.

The case then stands thus: Memphis has been the first city in this country

to adopt thoroughly the separate system of sewerage, as improved, designed and combined Mr. Waring. It is thoroughly satisfied with the result, the city has been reclaimed from the unhealthiness which scourged it, and during a four years' experience no hidden fallacy or defect in the system has appeared.

On the other hand Kansas City has begun to carry out the combined system, and after three or four years of experience is not satisfied with it.

The combined system is said by sanitarians to involve grave dangers to public health, while the most that is claimed by its advocates is, that if proper precautions be taken it is not so dangerous after all. On the other hand, the separate system is free from the slightest taint of suspicion. It is universally admitted to be healthy and safe.

Kansas City can even now probably save $1,000,000 by adopting the separate system for the portions of the town as yet unsewered, and even if this should not turn out to be true, even if a second set of sewers shall be needed some day, it is clearly better to carry out what is within our reach now: to adopt a cheap system which can at once be extended to all parts of the city in need of it, and to trust to the future resulting prosperity, to enable us to pay for the luxury of passing our storm-water underground.

But in point of fact, it is not true. It is in my judgment impossible that a second set of sewers for storm-water alone, shall ever be needed under all parts of our city; so that every consideration of economy and of sanitation points to the adoption of the separate system for the future.

SIXTEENTH ANNUAL MEETING OF THE KANSAS ACADEMY OF SCIENCE.

At 2 o'clock on the afternoon of November 20th, the Kansas Academy of Science met at the State House, in the Senate Chamber, at Topeka, the occasion being the sixteenth annual meeting of the society.

The meeting was called to order by the president of the society, Dr. A. H. Thompson, of Topeka. The following members of the academy were present at the opening: A. H. Thompson, Geo. S. Chase, T. J. Lovewell, G. C. Stearns, F. G. Adams, Topeka; Profs. E. A. Popenoe, Kellerman, J. D. Graham, Manhattan; R. J. Brown, Senator Aller, Leavenworth; Joseph Savage, Prof. Dyche, Prof. F. H. Snow, Lawrence; Robt. Hay, Junction City; J. R. Meade, Wichita.

After the call to order President Thompson made a short introductory speech, after which the regular business of the session was taken up, and Prof. Snow, Senator Aller, and Geo. S. Chase were appointed a committee on nominations to prepare a list of officers for next year.

The committee reported the names of the following officers: President, R. J. Brown, Leavenworth; Vice-Presidents, Prof. F. H Snow and Joseph Savage, Lawrence; Secretary, Prof. E. A. Popenoe, Manhattan; Treasurer, Dr. A. H. Thompson, Topeka; Curators, Prof. O. H. St. John, Prof. J. H. Carruth, and

Prof. J. T. Lovewell, Topeka. The committee further recommended that the president fill out the appointment of commissions.

The report of the committee was accepted, and the new officers were declared elected.

Robert Hay, of Junction City, made a verbal report of his geological and palæontological researches in Norton County. Mr. Hay spent the greater part of the past summer in that county, engaged in his scientific researches, and has made quite a curious and valuable collection of fossils and minerals. Chief among the fossils are portions of a mastodon. Many of the bones are in an excellent state of preservation. Several varieties of chalk were also exhibited.

Professor Cragin reported on the alcoholic specimens in the State Museum, and said that better accommodations would be furnished the Academy for their specimens in the future, as Secretary Sims of the State Board of Agriculture had promised to provide all necessary cases and jars, and the alcohol needed.

Professor Snow moved that the curators make a report on the condition of the museum and the necessary changes, before the close of the meeting.

The motion was carried, and Secretary Popenoe followed with a report on the library. On motion he was authorized to make a purchase of the missing volumes or sets, of the different States and societies.

At this point the new president, Dr. R. J. Brown, was escorted to the stand by Messrs. Snow and Savage, and Professor Snow made a short speech introducing him.

Dr. Brown responded and in doing so gave a brief history of the society and its past work, and stated that under his administration the enthusiasm and interest should not be allowed to flag. He believed the society was on the right road to success, and by united effort great good could be accomplished.

At the close of his speech the business was resumed, and Prof. Snow moved that twenty-five per cent of the annual dues be made a library fund. A general discussion of the library fund question followed. Senator Aller thought that the fund might be increased by increasing the membership of the society. To do this it would be necessary to hold the annual meetings in different places, instead of at Topeka every year. At the suggestion of the president it was found that the constitution provided for the annual meeting to be held in Topeka.

A motion was then made to have a committee on new constitution appointed, and Messrs. Snow, Savage, and Popenoe were so appointed, and requested to report Friday.

Prof. Cragin then stated that some steps should be taken by the society to secure the early publication of papers and the results of the Academy's researches from time to time, for the reason that several times in the past the Academy had lost the credit of certain scientific discoveries because their publication had been delayed until after somebody else had made the same discovery. Nothing else could be done, however, under the present circumstances, as the publications can only be made once in two years in conjunction with the reports of the State Board of Agriculture.

After some discussion on this point, the whole matter was referred to the executive committee, consisting of the secretary, treasurer, president and curators.

The question of the next place of meeting was also referred to this committee.

Professors St. John and Carruth being absent, Messrs. Chase and Savage were appointed to fill their places as curators and members of the executive committee.

The following new names for membership were presented to the society and accepted, after which the meeting adjourned until 7:30:

R. R. Moore, H. R. Bull, Mara Becker, D. C. Tillotson, C. H. Hallowell, Topeka; E. H. S. Bailey, Prof. Nichols, Dr. J. A. Lippincott, Lawrence; Thos. P. Fenlon, W. M. Fortiscue, Leavenworth; W. A. Kellerman, J. T. Willard, Manhattan; Ambrose Wellington, Carney; Dr. E. M. Turner, Norton; J. L. Meade, Wichita.

EVENING.—In the evening at 7:30 the members of the Academy assembled in the Senate Chamber to listen to the address of the retiring president, Dr. A. H. Thompson, of Topeka. Quite a large number of visitors were present, and the audience was very attentive throughout. Dr. Thompson's subject was, "The Origin and History of the Kansas Academy of Science," and it was admirably handled. Without being tedious it was comprehensive and complete, going back to the early history of the State when geological investigations were first made in 1855 by Major Hawn. In 1858 Prof. G. C. Swallow, of Missouri, and Prof. F. B. Meek made a report upon the "Rocks of Kansas." In 1864 Prof. B. F. Mudge made his first annual report as State Geologist. This last named gentleman, whose name will ever be held in high esteem among scientific men of the United States, will be especially revered in Kansas as the father of its scientific work. To his memory Dr. Thompson pays full tribute in the following words:

"But there is one man to whom we are more indebted, perhaps, than to all other causes combined, for all that we have and all that we are. Our origin, our maintenance during the years of our struggling and uncertainty and all our final success, are due to his enthusiasm, devotion and energy. One who was at once the best, the wisest, the grandest man whose name ever graced the annals of science in Kansas. I refer of course to Professor Benjamin F. Mudge. Any mention of the Academy or of its past work or purposes without naming Professor Mudge would be, to use a vulgarism, "like the play of Hamlet with Hamlet left out." The name and work of the Academy is inseparable from the name and work of Prof. Mudge. The Academy was his child and its very existence is due to the affection he had for it and the care he bestowed upon it.

It is an honor of which we shall ever feel proud, that our organization should have been the care of such a man; that he was mindful of it in the days of its weakness; that its prosperity gratified him and that he considered its welfare before all other societies which were honored by his membership.

Personally, the fullest praise can do scant justice to his many superior qualities of mind and heart; words cannot portray his delightful presence, his genial face,

his well-stored mind and his boundless kindness and enthusiasm. But he is gone, and we have left only the memory of his inspiring presence, our undimmed affection and the ever useful record of his works. And how we miss him at every step; the void is yet painfully vacant, four years after his untimely death. How we used him in every undertaking to counsel and help us. His loss to the Academy and to science in Kansas can never be estimated. It is scarcely too much to say that if he had lived we would have had a geological survey before this; for his extraordinary popularity throughout the State, and the profound respect and regard in which he was held by all classes of intelligent people, would have gone far towards securing that much desired enterprise.

I have collected some reminiscences of our dear friend and benefactor in connection with notes gathered relative to the steps taken toward the organization of the first natural history society and its history. They are from my gleanings, from contributions by different friends, especially by Mrs. Mudge, and from personal recollections. The first brief report of the geological survey of Kansas gives an outline of his early scientific labors in the State of his adoption. * * * * * It was during the war and attended with many difficulties. The field was new and its geological features entirely different from those to which he had been accustomed in his New England home. Though harder for him it only added zest to his enthusiasm, and he bravely overcame obstacles which would have discouraged one less in love with Nature and her laws. His own wants were few and simple. With public funds he was strictly conscientious, yet the appropriations for the survey were so small as to hamper him greatly, and he supplied provisions for the early part of his trip from the home larder to lessen expenses. His travels were sometimes perilous and frequently involved very hard labor. He was much perplexed when he had the main part of his report ready, to find that characteristic specimens which he had sent to the palæontologist carefully labeled, had been disarranged or lost, so that after embarrassing delays the report was finally put through the press incomplete. He never despaired of having more generous appropriations from the State when he or some other geologist would complete so important a survey. * * * * * * In lecturing he prepared his thoughts with care; but once having clearly fixed in his mind what he wanted to say, his retentive memory had no further use for the notes.

And how much we did enjoy those lectures! How the memory of them hangs like a fragrance about the walls of even this dingy capital building, where we have listened to him year after year. How contagious and inspiring was that exhaustless enthusiasm to all the young men with whom he came in contact. It was my privilege to have him for a near friend for many years and many are precious moments, in private conversation as well as in public lectures, that I have sat drinking at the fountain of knowledge which flowed in charming streams from his lips. How well I remember a day, years ago, when he came hurriedly into my office, on Kansas Avenue, all aglow with excitement, to inquire if I had een the tracks on a piece of Osage flagging which was being used as a cross-

walk on the avenue at Sixth Street. I was loth to admit that I had crossed and recrossed on the stone with the rest and like them had never noticed the tracks. But we went together to see the stone and sure enough there were the marks as distinct as could be and his beautiful enthusiasm was at its height. That was one of the first examples he nad seen of these tracks which he afterwards investigated and described so charmingly. He dropped all his affairs, went directly to the quarries the very next day and procured a quantity of the rocks with tracks.

While State Geologist, the delightful experience of discovering hitherto unknown fossils and the valuable economic deposits of Kansas, awakened in him a strong desire for the formation of scientific societies, not only for a wider dissemination of knowledge of these resources, but the preservation within our own borders of such rare specimens. He improved every opportunity by lectures and conversations to encourage a growing interest in science. The large area and the few railroads were discouragements to most people regarding a State organization, with perhaps a lack of interest. He really longed for the scientific companionship which he had enjoyed in the east from boyhood—the libraries, public societies, parlor clubs, field meeting of the Essex (now Peabody) Institute, long botanical excursions with congenial companions—how much he missed them. But in 1867 Rev. J. D. Parker, Professor elect of Lincoln College of Topeka, spent some weeks at Manhattan. He was fresh from his studies and an enthusiastic lover of Nature and together with Professor Mudge they prospected and walked, talked and planned. It is probable that it was at the tea table of Hon. J. T. Goodnow, with Professors Mudge and Parker, that the subject of a Natural History Society for Kansas was first broached. That is Mr. Goodnow's recollection of it. Prof. J. D. Parker writes in his obituary sketch of Prof. Mudge in the Kansas City REVIEW OF SCIENCE (Vol. 3, page 570) that, "during the summer vacation of 1867, he first became personally acquainted with Prof. Mudge, when by special invitation, he spent three royal weeks at his home in Manhattan. The days were spent in scientific rambles and in making collections in the vicinity, and the nights until a late hour in discussing scientific subjects. During this visit was matured the plan for organizing the Kansas Natural History Society, which afterwards grew into the Kansas Academy of Science. Of this organization Prof. Mudge was elected the first president and was again president at the time of his death. During those twelve years he was unwearied in his labors for the Academy, always cherishing plans for its development and growth and whose success formed one of the most jovous experiences of his life."

In no organization did he take a greater interest, and he has come in from the plains, hundreds of miles, bronzed and travel worn, to attend its meetings."

Full credit is also given by President Thompson to the earnestness and zeal of our friend Prof. J. D. Parker, and several interesting letters are given showing his deep personal interest in the Academy at all times.

Dr. Thompson's history of this Association extends down to the present time

and is replete with information, all interesting and much of which has never been put on record before. It will be published in the official report for 1883, and will form a valuable portion of that volume.

SECOND DAY.—On the morning of the 21st the Academy again met in the Senate Chamber and was called to order by the president.

Before the programme was taken up, the following new names for membership were proposed, and accepted by the society: Dr. Alice K. Brown, Jerry Fields and W. E. Sterne, Topeka; Judge Jas. Humphrey, Junction City; and W. S. White, Wichita. The regular programme was then taken up, the first department being that of Geology.

The first paper announced was "The Southwestern Extension of the Keokuk Formation, with Notices of its Fish Remains," by Prof. O. H. St. John, of Topeka. Owing to the absence of Prof. St. John on account of ill health, his paper was read only by subject, and the next paper, "Bibliography of Kansas Geology," by Mr. F. G. Adams, Secretary of the State Historical Society, was read. Mr. Adams' paper was a sketch of the various books touching upon the geology of Kansas, the story being briefly told in each case. The first book to which he referred was a History of Louisiana, published about the year 1809 by E. H. DuPratz. It contains an account of a visit to Kansas in that early day, and is full of valuable information. A number of other valuable works referring to the geology of Kansas were mentioned, and brief selections from some of them were read, as well as extracts from several scientific reports bearing upon the same subject.

At the close of the paper Prof. Savage gave some very interesting reminiscences of Hayden, the naturalist who was mentioned by Prof. Adams as among the prominent authorities on Kansas geology.

Prof. Savage was with Hayden in 1872, during an expedition to the Yellowstone, and became intimately acquainted with him. He related how Hayden, in 1857, then a young man, began his scientific investigations living among the Sioux Indians and studying the phenomena of Nature in the wild and unexplored regions of the West, and stated that Hayden had often told him that to his first winter's severe experience away from civilization, he owed all his later success.

The next paper was one entitled "Preliminary Report on the Geology of Norton County," and was read by Robert Hay, of Junction City.

This paper was unusually interesting from the fact that it was the result of careful scientific investigation by the author. Mr. Hay spent the summer in Norton County, the greater portion of the time engaged in making geological researches in that region. While there he discovered and exhumed a number of rare fossiliferous specimens, and made a valuable and interesting mineralogical collection, all of which he exhibited and explained to the Academy during the reading of his paper.

In treating the geology of Norton County he took up first its potamography and gave a full description of its river systems and their bed formations. Under this head he stated that he had found a number of formations, the first of which

was the Niobrara, or Cretaceous, composed of (1.) blue shale and (2.) yellow chalk. This formation was found principally along Solomon Creek, and imbedded in it were found occasionally crystals of calcite, cinnabar and quartz. The next layer he found to be green sand, and the fourth a greenish clay shale. Fifth in the group came the Loup Fork Miocene, with the Pliocene next, composed of a chalky, sandy marl. The seventh and last was the alluvium or soil. Mr. Hay took up as his second division of the subject, Stratigraphy, and treated somewhat at length of the dips and seams in the Norton County deposit. He stated that he had discovered in the county an unusually large break in the strata.

Under the head of Palæontology, he exhibited the following specimens of fossil remains found in the county: The entire lower jaw, part of upper jaw, four teeth, femur, two pelvic bones, humerus, radius, astragalus, os calcis, metatarsal and metacarpal bones of the rhinoceros (*aphelops*); teeth of three-toed horse, teeth of brontotherin, tooth of oreodon, portions of humeri of mastodon, radius and carpal bones of same, ribs of same, tortoise shell and skeleton nearly complete, fragments of three other turtles, tusk of mastodon, fragment of tooth of same, beaks of toothed birds and other cretaceous fossils.

The Professor urged strongly the establishment of a museum by the Academy, and stated that his specimens would become part of it, and that others would certainly be added by further explorations which are soon to be made.

Under the head of Economic Geology, he treated at length of the minerals of the county, and exhibited various specimens of sandstone, limestone, calcite, agate, jasper, rose quartz, chalcedony, feldspar, diorite, etc. Prof. Hay stated that coal was found in the Solomon Valley in small quantities as pockets in the blue shale, but he believed that coal would not be found in great quantities except at an excessive depth, probably three times as deep as the Leavenworth shaft. In all of his explorations Professor Hay was assisted by Dr E. M. Turner, of Norton County.

Professor F. H. Snow, of the State University, then gave a verbal report on "The Bones of Fossil Horse and Rhinoceros from Northwest Kansas," and in doing so exhibited a number of specimens from the collection at the State University. Professor Savage then spoke of the field that Norton County had afforded for investigation, and believed there were other counties in the state equally as fruitful.

The next paper was one entitled "The Loup Fork Group in Western Kansas," by Prof. C. H. Sternberg, of Lawrence. The paper was principally an exhortation to the State and State authorities to arrange for a museum, and as Mr. Sternberg was absent, the paper was read by title and referred to the committee on publication.

The next, "Note on New Kansas Mineral," by Prof. J. T. Willard, of the Agricultural College at Manhattan, was read by title also, as the professor was absent.

Prof. Snow read a short paper on "Octahedral Limonite," communicated by Prof. Erasmus Haworth, of Penn College, Iowa.

This was followed by a paper on "The Age of Kansas," by B. B. Smyth, of Topeka. He treated extensively the river systems and their geological characteristics. Also referred to the atmospheric and meteorologic phenomena, and gave an account of a sand-storm which occurred in 1880, during which fine sand was carried in clouds from Barton County to the eastern part of the State.

The paper of J. C. Cooper, of Topeka, "Notes on Some Rare Minerals New to the United States," was called, but owing to author's absence, the paper was read by title only, and referred to the committee on publication.

AFTERNOON SESSION.—At 2 o'clock in the afternoon the Academy again convened, with Dr. Brown, the President, in the chair. The first hour was devoted to business. The committee appointed on Wednesday to revise the constitution and by-laws of the society made its report. On motion the constitution was adopted as a whole. On motion it was unanimously decided to hold the next annual meeting at Lawrence in November, 1884.

The curators of the Academy's museum then made a report, which was adopted. We can give but the portion containing the recommendations of the committee, viz.:—That the curators of the Academy be authorized as a special committee to proceed to thoroughly overhaul the collections now in the cases referred to; to re-label and arrange such portions thereof as can be located with certainty, and to clean the shelves of such portions as have lost their value by reason of their localities being indeterminable; to gather together the scattered and unboxed material and arrange and label as much thereof as may be practicable, and to store away the balance of the material somewhere in the building where it may be found, should occasion ever require. In the prosecution of this work that the committee be allowed $15 for assistance and material, and that they be allowed to make any exchanges that they may consider practicable.

"Your committee are informed that the present secretary of the Agricultural Board is willing to furnish additional cases for the use of the Academy's collections and to turn over to the Academy all collections now in the possession of said board, which relate only to natural history subjects.

Your committee would therefore recommend that the curator's committee be authorized to confer with the Secretary of the State Board of Agriculture, who is at present absent from the city, and arrange with him for the construction of such cases, and such arrangement of the same as may be found most expedient, and that such curators be authorized to receive from the Agricultural Board all such collections as such Board may consent to turn over to the Academy and to provide for the care of the same.

A motion was then made to add Geo. S. Chase and Professor Cragin to the permanent board of curators, thus making five in all.

The business session was then closed to make way for the regular programme.

Prof. L. L. Dyche, of Lawrence, detailed the particulars of the finding of

the mammoth (*Elephas Americana*) at Newton last spring, Prof. Dyche having examined the fossil soon after its exhumation. He stated that the entire specimen has been disposed of to eastern parties.

The following topics of Prof. F. W. Cragin, of Washburn College, Topeka, were read by title and referred to the committee on publication: "Notes on the Embryology of Porcellio," "Notes on some *Crustacea* of Kansas," "Additions to the List of Kansas Reptiles and Batrachians," "List of *Hymenomycetes* Collected near Topeka," "Key to the Known Species of *Cyclops*."

Prof. I. D. Graham, of the Agricultural College, and Prof. Cragin, had each prepared a paper on "Preliminary List of the Fishes of Kansas," and upon consultation it was decided to combine the two, so they were read by title and ordered referred to the committee on publication when ready. An excellent paper on "Practical Fish Culture," was presented by Prof. I. D. Graham. The paper was very interesting and instructive, and evinced close study and careful investigation.

Under the department of Ornithology Prof. Popenoe read the following short papers by N. S. Goss, of Topeka, the State Ornithologist: "Birds New to the Fauna of Kansas, and Birds Rare in the State;" "Notes on the Nesting Habits of the Yellow-Throated Vireo (*Lanivireo Flavifrons*); Observations on the Breeding Habits of the American Eared Grebe (*Dytes nigricollis Californiatus*).

Professor F. H. Snow then followed with a brief verbal report on the "New Species of Lepidoptera, discovered in New Mexico in 1883." These new species, twenty-five in number, were discovered by himself while sojourning there during the past summer. He then took up the topic, "Additions to the List of Kansas Coleoptera in 1883." This was also a brief verbal report, and the professor stated that the list of Coleoptera would now number about 2,000 in Kansas, the largest list in the United States by a single society belonging to one State or Territory, except the list of the Coleoptera of the District of Columbia, which numbers 2,800, as prepared by a Washington scientist. The professor stated that the Academy hoped to beat this record before a great while. Prof. Snow then continued with "Further Observations Upon the Gila Monster (*Heloderma suspectum*)." He gave a verbal report and stated that from experiments he had been led to believe that the reptile was not poisonous though it was generally believed to be so. At the close of his remarks, a general discussion of the subject arose, and several interesting facts in regard to experiments with this species of lizard were brought out.

The next subject, "Observations on the Habits of Ants," was handled by Prof. Joseph Savage. He made a very short verbal report, merely calling the attention of the Academy to the fact that in the ant-hills of the plains he had always found Indian beads in great quantities. He explained this by stating that these beads were carried there from great distances by the ants themselves.

Prof. Frank Kizer, of Emporia, then, by the aid of a set of drawings, ex-

plained the Indian sign-writing, and noted a number of interesting facts in connection therewith. The drawings were copied from a large rock in Greenwood County upon which they had been made by the Osage Indians.

EVENING.—In the evening a large audience was assembled in the Senate Chamber of the State House to listen to lecture of Dr. R. J. Brown, of Leavenworth, President of the Academy.

The subject of the lecture was "The Ocean—Its Flora and Fauna," and the lecture was interesting throughout.

Dr. Brown has been spending considerable time on the Atlantic coast during the past summer and has put together in a very interesting form the impressions made on him by the seaside phenomena, and illustrated the lecture by fine diagrams showing the depth of the ocean bed, kinds of coral, etc. He had also specimens of shells and corals from Florida and elsewhere.

The lecturer spoke of the primeval ocean before all geologic ages and the first appearance of continental land, and the gradual appearance above water of all the land of the world built by the waters; some like chalk and limestone by animals—corals and diatoms and foraminifers; some from the breaking down of the former rocks in the shallow sea and the gradual deepening of the ocean bed. The distribution of heat by the oceanic current was dwelt upon, the depth at which the Fauna and Flora exist, and the magnificence of the latter was described. It is more than likely that this paper will be published in full in the next number of the REVIEW.

On the following day Dr. Brown was elected a life member of the Academy because of his exceedingly liberal donations from time to time to the Academy. This was a double compliment, from the fact that Dr. Brown is the first person upon whom the Academy has conferred the honor.

THIRD DAY.—The meeting was called to order at 9 o'clock by the President, Dr. Thompson. For the purpose of expediting the publication of some of the most important papers read, the following resolution was passed:

Resolved, That the publication committee be instructed to publish at once their selection of the papers under the best arrangement they can make, and for any cost which the Academy's treasury may not be able to meet, they be empowered to levy and collect any additional assessment not exceeding $2 each.

Professor F. W. Cragin was elected librarian.

The committee appointed to audit the expense account of Prof. Hay, who made geologic researches in Norton County during the past summer, reported favorably and the claim of $92.30 was allowed. Besides allowing the claim the committee and society complimented the professor upon the successful results of his explorations in the interest of science.

The department of Botany was taken up and Prof. W. A. Kellerman gave an interesting lecture on "New Fungi of Kansas." Prof. Kellerman followed closely the classification of Cohn, giving the following divisions of Fungi: Protophyta, Zygosporeæ, Oosporeæ, Carposporeæ, Bryophyta, Pteridophyta. Taking up each division separately he gave the various classes and explained the

phenomena of the reproduction and growth of each, illustrating his remarks by charts and drawings. Four new Fungi have recently been discovered in Kansas, all of which are parasitic in their nature and are found on plants. A number of microscopic specimens of parasitic Fungi were shown, together with the leaves upon which they were found.

Under the department of Anthropology, Mr. F. G. Adams, of Topeka, Secretary of the State Historical Society, presented an interesting paper on "The Metate," or stone mill used by the Indians of New Mexico and Arizona in grinding corn. He exhibited one of the mills, which consists of a stone mortar and pestle and explained fully the method by which the corn or wheat is ground. The mill exhibited is evidently of lava stone, and is in possession of the State Historical Society. Mr. Adams explained the method of using the mills and stated that they were still in use among the Indians in Arizona and New Mexico.

The committee on State Geological Survey which was appointed last year made a report to the Academy through the chairman of the committee, Mr. Geo. S. Chase. The report was quite lengthy, detailing in full the history of the origin and fate of the bill which was introduced in the Legislature asking for an appropriation of $10,000 for the survey. The bill, it will be remembered was lost, though great efforts of its friends were used to secure its passage.

At the close of the reading, the report was adopted, and the committee, as follows, was continued: Geo. S. Chase, Chairman, Prof. J. T. Lovewell, Dr. A. H. Thompson, Rev. Peter McVicar and Henry Inman, of Topeka; Prof. F. H. Snow, Prof. G. E. Patrick and Prof. Joseph Savage, of Lawrence; Prof. E. A. Popenoe and Prof. G. H. Failyer, of Manhattan; Dr. R. J. Brown, of Leavenworth; and Prof. Robert Hay, of Junction City.

While the subject of a geological survey was under discussion, Governor Glick arose and addressed the Academy. He stated that in 1864 a geological survey was begun by the State, and a State geologist was appointed, but the second year a dispute arose over the office of State geologist and the survey was discontinued. The Governor believed that a State survey would be of vast benefit to the State, and he was very anxious that the Legislature should provide for such a measure. He hoped the members would continue to agitate the question until they secured the final passage of a bill appropriating the funds necessary for such a work. He spoke of the surveys of other States and said that Illinois had to agitate the question many years before getting a State survey, Ohio was fifty years old before the measure was secured, and Indiana was nearly the same age. However, he believed that Kansas would secure an appropriation for such a survey before many years. Kansas, he stated, was developing rapidly and needed such a survey. Her development was more rapid than any State in the Union, and she was fully able to appropriate money for a geological survey soon.

Mr. Geo. S. Chase, the chairman of the committee was called upon to read the bill which was introduced in the last Legislature and voted down. The committee on survey was asked to make a report again at the next meeting of the Academy.

Prof. F. W. Cragin, of Washburn College, Topeka, then read a paper "On the Ruins of the Cliff Dwellers of Chapillo, Blanca and Pareto." The professor gave an interesting account of his observations among these ruins, which are about forty miles west of Santa Fe, N. M., and referred to the curious ancient drawings found upon the rocks in the cliffs of that region. Prominent upon those noticed was a figure shaped like a Spanish cross, and also a drawing representing a mastodon. This was considered very curious from the fact that the drawings are probably 2,000 years old.

AFTERNOON SESSION.—In the afternoon at 2 o'clock the Academy again assembled in the Senate Chamber and was called to order by the president.

By request, Prof. Hay, of Junction City, who exhumed the fossils in Norton County, occupied ten minutes in exhibiting and explaining the specimens to the members of the classes in Chemistry and Natural Philosophy of the Topeka High School who were brought in by Prof. Larimer.

Mr. J. T. Willard, of the Agricultural College at Manhattan, read a short paper entitled, "Note on a New Kansas Mineral." The mineral, of which he exhibited a specimen, is ferrous brown, appearing like Hæmatite, and was found in the northern part of Riley County. The mineral when first discovered was supposed to be hæmatite, but on close analysis was found to be manaconite, a variety of iron ore similar to hæmatite but differing slightly in its action under the blow-pipe and with acids.

The department of Physics and Chemistry was the next taken up and an exhaustive paper on "Purification of Water for Domestic and Manufacturing Purposes," was presented by Mr. Wm. Tweeddale, of Topeka. This paper was quite lengthy and treated fully of the subject in its various and varied relations.

The next paper "Is the Sun Composed of Fire?" was read by title and referred to the committee on publication, the author, Mr. F. E. Jerome, of Russell, being absent.

Mr. Geo. S. Chase followed with "Archæological Notes," which belonged properly in the department of Anthropology, but had been deferred on account of Mr. Chase's absence when the paper was regularly called. This paper gave an account of a trip made by the author to New Mexico, and he gave an account of some relics found near Taos, New Mexico. Mr. Chase exhibited several small black stone images which he believed were used by some prehistoric race either as an object of worship or as a sign of rank, probably the latter.

Dr. Thompson believed that such images were treasured by Indians of the present day, having been made by their ancient predecessors, not so much as objects of reverence as signs of rank.

Professor Savage made a short address on "Lightning Freaks during the Summer of 1883," and in doing so referred to a small cyclone which he had witnessed. The cyclone, shaped like an inverted cone, while revolving rapidly would occasionally separate near the ground, and then come together again. Each time as the points of the two portions of the cyclone came together a blue flame was seen to pass apparently from the ground to the top of the cyclone. Profes-

sor Savage also described the electrical phenomena of the severe storm on the night of July 10, 1883.

Professor E. H. S. Bailey, of the State University at Lawrence, presented a very practical paper on "The Composition of Vessels for Culinary Use." He explained why new tin vessels were somewhat poisonous, and advised thorough cleansing of them before using. He also referred to the poisonous character of copper and brass vessels, and stated that particular care should be taken in their use. He followed this by a paper on "The Distribution of Saccharine Matters in the Stem of *Sorghum Vulgare*." This paper was a very practical one and detailed a number of experiments in the analysis of the plant in its different stages of growth. The professor exhibited a table in which is shown the result of a number of experiments that may prove valuable to sugar manufacturers. It was found on analyzing the various joints of the sorghum plant that the per cent of glucose or that part of the cane product which forms molasses and not sugar, decreases from the first or bottom joint to a minimum near the middle and then increases toward the top joint where it reaches a maximum per cent. On the other hand the sucrose which forms the sugar, begins in the first joint with a per cent about three times as great as the glucose, and increases to its maximum near the middle of the stalk, decreasing to a minimum in the top joint. This is the proportion noticed in the thoroughly ripened plant, but in the greener samples the glucose and sucrose become more nearly equal in their per cents. It will thus be seen that the part of the plant most productive of sugar is the middle.

Professor E. L. Nichols, of the State University at Lawrence, made a short lecture on "A New Class-Room Experiment upon Ebullition." He referred to a method of super-heating water above the boiling point without allowing ebullition to take place. He illustrated his lecture freely with diagrams and sketches, and made it interesting throughout.

At the close of this paper the High School pupils in charge of Prof. Larimer arose to retire and while standing were addressed by Dr. Brown, the President of the Academy. He urged the students to take up some department of science and make it a specialty. He stated that even after graduation they would find the pursuit of such a study not only profitable but pleasant. He thanked the students for their visit to the Academy, and expressed the hope that he would meet them again as earnest workers in the scientific field.

Professor Larimer, on behalf of the students, expressed their gratification at their reception and the interesting information obtained by their visit, after which the school retired.

"The Utilization of Mineral Waters," by Prof. E. H. S. Bailey, of Lawrence, was read by title, and referred to the publishing committee.

Professor H. E. Sadler, of the State Normal School, at Emporia, read a paper on "Coal Oil Legislation," in which he referred to the fact that the coal oil trade had become a great monopoly, and that unless legislation were used in the interest of the subject the oil would become even more adulterated than it now is. There is no law in Kansas to prevent the selling of even the most im-

pure and dangerous oils, and he believed that stringent laws should be enacted.

Miss Mara Becker, of Washburn College, read a short paper on the "Well-Waters of College Hill" giving in tabular form the results of a number of chemical analyses of the well-waters on the college grounds.

Mr. R. R. Moore, of Washburn College, gave some "Notes on Waters Used by the Sonora R. R. Co., in Steam-Boilers," the results of a series of practical experiments by himself.

Mr. H. R. Bull, of Washburn College, closed the programme with "Notes on Tea Analysis," the results of another series of experiments.

A resolution was passed by the Academy thanking the *Capital* and *Commonwealth* for their reports of the proceedings, in which we cordially join, having freely used them in this account. The names of C. S. Gleed and Rev. L. Blakesley, of Topeka, were presented for membership and they were accepted.

With a few parting words to the members of the Academy and urgent requests to be present at the next annual meeting to be held at Lawrence, the president pronounced the meeting adjourned.

In the evening the members of the Academy and their friends were pleasantly entertained at the home of Prof. J. T. Lovewell, near Washburn College.

In a paper read at the recent meeting of the National Academy of Sciences, Prof. J. S. Newberry gave the results of his thirty years' travel and investigation in those parts of North America, which bear evidence of glaciation. He claims to have found conclusive testimony that at least one-half of the continent has been the seat of ancient glaciers, some of which must have been at least 500,000 feet in thickness. The proofs are most pronounced, he says, in Washington Territory, and among the lakes and fissures of Yellowstone Park, where geologists sent out for the purpose by the Government are now engaged in making a thorough and systematic examination. He adds that he is fully convinced that the irregular line of lakes in the eastern part of British America was formerly a river in which glaciers settled and widened and broke the bed of the river.

ENGINEERING.

THE ALLEGHANY PORTAGE RAILROAD.

H. C. WEAVER.

The discussions concerning Captain Eads' ship railroad across the Isthmus within the last few years calls to mind a similar railroad built and operated in Pennsylvania when I was a boy, some details of which may interest the readers of the REVIEW.

This road extended from Hollidaysburg, on Juniata, over the Alleghany Mountains to Johnstown, on Conemaugh, a distance of 36 69-100 miles. Its construction was authorized by an act of the Legislature of Pennsylvania approved March 21, 1831. The engineering work was commenced the next month and the work of construction began the following summer. On the 18th of March, 1834, the road was opened as a public highway.

It consisted of eleven "levels" and ten "inclined planes;" the latter being numbered from Johnstown eastward—five on each side of the summit. The details of the planes were:

No.	Length in feet.	Rise in feet.
1	1,607.74	150.
2	1,760.43	132.40
3	[1]1,482.50	130.50
4	2,195.94	187.86
5	2,628.00	201.64
6	2,713.85	266.50
7	2,655.01	260.50
8	3,116.92	307.60
9	2,720.80	189.50
10	2,295.61	180.52

The "summit" is 1,398 feet above Hollidaysburg; 1,171 feet above Johnstown; or 2,325 feet above mean tide in the Atlantic Ocean.

At the head of each inclined plane were two stationary engines of thirty-five horse-power each. One was in active use; the other was "reserve" to be used in case of accident. These propelled endless wire cables to which the cars were attached. On the "levels" between the planes horses were used to move the cars; subsequently locomotives were supplied to some and perhaps to all the "levels."

The cost of the road was $1,783,176. This does not include the expense of the new road afterward constructed to avoid the "planes." Subsequent expenses charged to cost ran the sum to $1,828,461.38.

The Pennsylvania Railroad Company became the owner of the Allegheny Portage Railroad, on the 1st day of August, 1857. It was included in the sale by the Commonwealth of the "Main Line" under the act of May 16, 1857. The cost of the "Main Line" as computed in 1843, was as follows:

Columbia Railroad	$4,204 969.96
Eastern Division of Canal	1,736,599.42
Juniata Division of Canal	3,521,412.21
Portage Railroad	1,828,461.38
Western Division of Canal	3,069,877.38
Total	$14,361,320.35

1 Possibly only 1,480.25.

The consideration to be paid by the P. R. R. Co. for these improvements was $7,500,000 and $1,500,000 in consideration of a release of tax on tonnage.

The length of the "levels," I am not able to give at present. They were not "dead levels," but had, generally, an inclination of from ten to fifteen feet per mile. Those nearest Hollidaysburg and Johnstown had steeper gradients. Sylvester Welch was engineer in charge of the construction of the Allegheny Portage Railroad. In October, 1834, Jesse Chrisman started from Luzerne Co., Pennsylvania, with a small boat containing ten or eleven persons, with provisions, cooking utensils, etc., en route for the west. At Hollidaysburg, Pennsylvania, he intended to dispose of the boat, but at the suggestion of John Dougherty, who constructed a railroad car for the purpose of carrying Mr. Chrisman's boat over the Alleghany Mountains, the boat was again launched in the canal at Johnstown and proceeded on its way to Pittsburg.

The Portage Railroad was completed in the fall of 1883. In transporting freight from Philadelphia to Pittsburg it required the bulk to be broken three times, first at Columbia, to which point the railroad ran from Philadelphia, when it was transfered from the cars to the canal-boats; then again at Hollidaysburg it had to be transferred from the boats to the cars; and again at Johnstown, on the western side of the Alleghany Mountains, it had to be transferred from the cars to the boats.

Mr. Dougherty invented the trucks for the purpose of conveying what were called section boats, (also his invention). These boats he placed on the canal in 1836; some were made in three and some in four sections. These boats were loaded in Philadelphia and carried on the railroad on trucks, or flat-cars, to Columbia, then run into the canal. The sections hooked or fastened together ran to Hallidaysburg and were then loaded upon the trucks again. By having the track laid into the water the cars were run in under the boats, and again the boats were run into the canal at Johnstown, and sent to Pittsburg, and returning eastward they were operated in the same way. Prior to placing the section boats on the main line of the Pennsylvania Canal, freight had been shipped from Philadelphia to Pittsburg without breaking bulk, by means of what were called "car-bodies,"—large boxes—that were constructed like a small box-car with wheels: they were carried on flat-cars and were carried on the canals in open boats constructed for that purpose that plied between Columbia and Hollidaysburg, and between Johnstown and Pittsburg. These boats were long enough to admit from four to six car-bodies; the latter were placed on trucks loaded at Philadelphia and carried by rail to Columbia, there by huge windlasses they were lifted from the trucks and placed in the open boats, and transported to Hollidaysburg; again placed on the trucks and at Johnstown again put in the open boats, etc., and returning eastward the operation was reversed. James O'Conner was the originator of the car-body method of transportation. Mr. O'Conner was an Irishman by birth, and a man of some education, and this was called O'Conner's Line of boats. I may say that while Mr. Welch was the engineer in charge of construction of the Portage Railroad, Moncure Robinson is entitled to the credit of conceiving the plan.

One of the projects for surmounting the barrier presented by the Alleghany range was to construct a canal tunnel, about five miles in length, from the upper waters of the Juniata River to those of the Conemaugh River, and singular as it may seem half a century afterwards this project was abandoned because of the limited supply of water. Some idea of the volume of transportation can be formed from the fact that in the summer of 1834 1,220 boats passed the town of Huntingdon, showing the vast amount of freight carried at that early day, in the history of internal improvements. I am indebted to the Hon. J. Simpson Africa, Secretary of Internal Affairs, Pennsylvania, and John Dougherty, Esq., for valuable data in the preparation of this article.

STREET PAVEMENTS.

THEO. S. CASE.

A most important subject in a growing city is the construction of its streets, i. e., their grades and their paving. The former are controlled largely by the topography of the city itself, and the latter should be governed by the former; also by the various questions of utility, adaptability of home material, cheapness, durability and hygiene. For a city to remain in the mud when any kind of paving material, that will lift her out of it, is accessible, is not only inconvenient and disagreeable, but it is expensive. Business, which governs everything, first demands facilities involving speed and cheap handling of heavy loads. The mud-pike is evolved from the ordinary dirt-road, the corduroy road is the natural precursor of the plank-road, the gravel-road precedes the Macadamized road, then follow the Nicholson pavement, the cedar-block, the Russ or Belgian stone-block, the Medina sandstone, the asphalt. Each in its turn has its advocates and its day, and each in its turn is denounced for its faults and abandoned for its successor. Each, however, has its advantages and adaptabilities to particular localities, but when the tide of fashion or prejudice or favoritism comes along these attributes are lost sight of.

In cities that have passed the formative stage and are settling down into permanency, the principal materials used in paving are wood and stone, with all manner of experiments upon combinations, shapes and construction; and it is somewhat singular that the errors of cities have very little weight in preventing their repetition in others. While wooden blocks are being thrown out as worthless in Washington, they are being largely laid down in Chicago, Kansas City, and even in London. While stone is strongly urged as the only permanent material in some of our western cities, it is regarded by the best engineers in some of the eastern cities as second to asphaltum blocks and even to wood. The fact is that the circumstances of climate and topography, together with the proper or improper manner of construction, are factors too little considered both by engineers and city governments. Wooden pavements are laid on wet foundations, slippery stone blocks on steep grades, and contractors are permitted to evade the

terms of their agreements in construction, and yet dissatisfaction is expressed at want of success in attaining the objects desired.

Whether in ancient times better roads and pavements were built than at present, or whether only the best ones remain, is uncertain, but it is certain that some of the remains of such structures found, in Rome for instance, evince engineering skill and perfection of work in a high degree. These were laid out carefully, excavated to solid ground, or in swampy places made solid by piles. Then the lowest course was of small-sized, broken stones, none less than three or four inches in diameter, over these was a course, nine inches thick, of rubble or broken stones cemented with lime, well rammed: over this a course, six inches thick, of broken bricks and pottery, also cemented with lime; upon this was laid the *pavimentum* or pavement, composed of slabs of the hardest stone, joined and fitted together as closely as possible. This was costly—the Appian Way, about one hundred and thirty miles in length, having almost exhausted the Roman treasury —but it was as enduring as Nature's own work. In Peru and Central America similar remains, 1,500 to 2,000 miles long, were found by the Spaniards, which, as Prescott says, "were built of heavy flags of freestone, and in some parts, at least, covered with a bituminous cement which time has made harder than the stone itself." The roads of modern times lack most of the elements of durability which these possessed and consequently wear out in a very few years.

The greatest enemy to wooden pavements is damp air. If wood is submerged in water or if it is kept perfectly dry it will not rot, but if it is exposed to moist air it will rot rapidly. It can be protected to a very considerable degree against wear by protecting the surface, hence all that is necessary to render it very durable is to insure it against exposure to dampness. The method of preparing the foundation at present adopted in Kansas City, i. e., constructing it of broken stone cemented together with water lime, is admirable, provided the surface moisture from rains, etc., can be kept from penetrating the interstices between the wooden blocks and resting upon the cemented surface below. If this cannot be prevented, then the foundation would be better without the cement, for it is plain that the blocks must, so to speak, stand with their feet in the water all the time, and their rotting must begin at once. But if the coal-tar or asphaltum, now sparingly and uselessly thrown upon the surface of the blocks, can be poured upon them so abundantly as to fill the interstices and prevent the water from passing down to the concrete below, we shall find that the rotting process will be indefinitely delayed and that the wear will also be vastly decreased. As we cannot keep the blocks submerged, we must keep them dry and protected from the action of the air—oxidation—to the fullest extent possible. These remarks of course apply to the work in relaying the blocks after removal for repairs of sewers, gas-pipes, water-pipes, etc., and to the work done by the street commissioner in keeping the streets in repair. He should be supplied with proper material and be required to inspect such paving frequently, filling all cracks or openings of every kind as often as observed. In this way wooden pavements may be made

as durable as they are pleasant in other respects, while at the same time they will still remain less expensive than stone.

As to stone pavements, the Guidet, Belgian, and Camp or Medina sandstone, are equally valuable and durable, each being first-class for streets upon which heavy traffic is done, and each being decidedly objectionable everywhere else But to give the best results at the heavy cost of such pavements they should be kept scrupulously clean; otherwise they have all the inconveniences of slipperiness, dust and slop, in addition to the almost intolerable noise which essentially belongs to them. On heavy grades the stones should be set sloping, so as to produce projections at their edges for the benefit of the draft animals in pulling up or holding back in going down. Without attention to this, much of the benefit of the stone surface is lost, from the fact that so much smaller loads must be hauled over them.

The ideal pavement in our opinion is that composed of asphaltum, either in solid sheets or in blocks. It is noiseless, indestructible by the elements, smooth, impermeable by liquids, easily cleaned and when properly put down, exceedingly durable, besides being easily put in perfect repair when cut or broken for any reason.

The foundation should be of the best quality, as it should for all other pavements, and the asphaltum mixture put on in sheets on level stretches and in suitably sized blocks, laid as above, upon all steep grades.

As to the comparative durability of these three styles of pavement, assuming the foundation to be about the same in each case, experience shows that stone blocks of good quality will last the longest time, wooden blocks the shortest and asphalt blocks will come between the other two. In the matter of cost, wooden blocks will cost least, asphaltum next, and stone most. In cost of maintenance and repairs, rock comes first in point of economy, asphaltum second and wood last. In regard to hygienic value, asphaltum stands conspicuously first, stone next, wood last.

After carefully considering the matter as a home measure, while I am satisfied that the above summary is correct, I am also quite convinced that be substituting a cheaper wooden block for the cedar, and expending enough more upon the point of making the pavement impervious to water from above, to actually accomplish it, we can have a cheap pavement in this city which shall possess all the good qualities of both stone and asphaltum, at a lower cost than either, and use no materials except such as can be found in our immediate neighborhood.

At the present time there is a growing sentiment among the people of St. Louis in favor of pavements made of fire-clay brick, which have been carefully tested and pronounced a success in a report made by a committee of engineers and citizens. Among other things they report that "these bricks show all the endurance of granite," "they make a smoother, cleaner, and less noisy street," "are more easily repaired," "give better foot-hold to horses," "neither fire nor frost affects them," and "that streets can be made of this material at half the cost of granite."

BOTANY.

INSECTS AND COLORED FLOWERS.

REV. L. J. TEMPLIN.

In the *Popular Science Monthly*, Vol. XIV, pp. 529–30, is a short letter written by Thomas D. Lilly, of Virginia, in which he details some observations in regard to the influence of color in flowers in attracting insects to them. He speaks particularly of petunias and morning-glories. He says: "In every variety of situation and circumstance the white petunias have been neglected for the colored, in exact proportion to the intensity and vividness of color; and the same is found to be true, in a less degree, as regards the deep and pale morning-glories." The conclusion at which he arrives is that it is the color, and that only, that determines the visits of bees and butterflies to these flowers, for he states that,—"If there was any difference whatever in the sweetness or fragrance, it was in favor of the rejected white flowers." If these statements are to be accepted, the conclusion is, or the conclusion the writer would have us draw is that in their visits to flowers, insects are guided neither by their sense of smell nor by their past experience as to the sweetest flowers, but wholly by their sense of sight; and that is guided and controlled, neither by the shape nor size of flowers, but entirely by the brilliancy of color. This seems to be but a limited statement of the views held by evolutionists in general as to the influence of color on the perpetuation and dispersion of both plants and animals. We are told that the brilliancy of color in both birds and insects is the accumulated results of the æsthetic taste in them that leads to the selection of the highly colored ones of their own species as mates to the neglect and rejection of those less favored in the beauty of their adornment. Mr. Grant Allen, speaking of this in butterflies, attributes it to a real enjoyment that they derive from the contemplation of beautiful colors. In "The Evolutionist at Large," he says: "It is sufficient to believe that the insect derives some direct enjoyment from the stimulation of pure color, and is hereditarily attracted by it wherever it may show itself. This pleasure draws it on, on the one hand, toward the gay flowers that form its natural food, and on the other hand, towards its own brilliant mates.

As to this last he says: "But out of two or three such possible mates it naturally selects that which is most brightly spotted, and in other ways most perfectly fulfills the specific ideal." But notwithstanding the pleasureable sensations that prompt it to seek the brilliantly colored flowers the butterfly, is all unconscious of any such influence, for according to this savant it is all unconscious of any such influence whatever, and is moved only by a blind impulse over

which the insect has no control. Speaking of a new born butterfly, he says: "Soon a flower catches its eye, and the bright mass of color attracts it irresistibly, as the candle-light attracts the eye of a child a few weeks old. It sets off toward the patch of red or yellow, probably not knowing beforehand that this is the visible symbol of food for it, but merely guided by the blind habit of its race, imprinted with binding force in the very constitution of its body. Thus the moths which fly by night and visit only white flowers whose corollas still shine out in the twilight, are so irresistibly led on by the external stimulus from a candle falling upon their eyes that they cannot choose but move their wings rapidly in that direction."

And again, "The butterfly in like manner is attracted automatically by the color of his proper flowers, and setting upon them, sucks up their honey instinctively." So also, "The picture of his kind, as it were, is imprinted on his little brain, and he knows his own mates the moment he sees them, just as intuitively as he knows the flowers upon which he must feed." So after all it is not any æsthetic taste that guides his choice, nor is it choice in any correct sense that determines the result, but simply a blind, unintelligent and irresistible impulse over which the insect has no more control than has the falling leaf over the attraction of gravitation that draws it to the earth. And yet we are to believe that this blind force has been so controlled by æsthetic emotions as to produce all the beauty of color displayed in the petals of flowers, the wings of insects and the feathers of birds. Now we are taught that this love of the beautiful, or, at least, the attractive power of bright colors in flowers and fruits is the great means employed by nature to secure the fertilization of flowers and the distribution of seeds. We may stop here and inquire if it be true that plants with brilliant colored petals are more prolific or receive the attention of bees as fertilizing agents more surely than others.

The honey-bee, with which we are better acquainted than with any other honey-eating insect, may be taken as an illustration. Does this visit only or principally brilliantly colored flowers? It strikes me a careful examination of the habits of this little friend will throw a flood of light on this subject.

Having given considerable attention to the subject of bee-plants, I offer the following list as comprising the principal ones throughout a large portion of our country. I insert the color of the flowers of each:

Alsike clover—red and white.
Boneset—white.
Blackberry—white.
Buckwheat—white.
Basswood—white.
Catnip—reddish tinge.
Clematis—white.
Cleoma—purple.
Currant—yellowish white.

Corn—red and white.
Dandelion—yellow.
Fruit trees—pink and white.
Golden rod—yellow.
Gooseberry—yellow.
Grape—greenish white.
Horehound—white.
Iron-weed—purple.
Mignonette—yellowish white.
Maple—red and white.
Mustard—yellow.
Oxeye daisy—white.
Raspberry—yellowish white.
Red clover—red or pink.
Strawberry—white.
Smartweed—pink.
Silk, or milkweed—purple to white.
Sweet clover—white.
Turnip—yellow.
Tulip-tree—yellowish white.
Virginia creeper—greenish white.
Willow—purple or white.
Wild plum—white.
White clover—white.

Here we have a list of thirty-two of the principal bee-plants of the country. I think any apiarist who has given careful attention to the forage plants of his bees will admit that nine tenths of the honey that his bees collect is gathered from the plants enumerated above; and yet a large proportion of them are white. Indeed, I think in a large portion of our country it is safe to say that three fourths of the honey is gathered from three species of plants—buckwheat, basswood, and white clover; all of which have white flowers. Many of the plants named above have very inconspicuous flowers, of which I may name maple, raspberry, grape, Virginia creeper, currant, gooseberry, sweet clover, and corn. If it were the bright colors alone that attracted bees to flowers, some of these would never receive the visits of a single honey-gathering insect. But observation proves that the inconspicuous flowers are often thronged by insects to the neglect of more showy ones. As an illustration, a vine of Virginia creeper that clambers over my house was literally swarming with bees during the past summer, when sunflowers, roses, and hollyhocks, in its immediate vicinity were entirely neglected.

The "yellow patches" of sunflowers could readily be seen for half a mile, while the minute blossoms of the ampelopsis could scarcely be distinguished at the distance of a rod. I also observed a similar fact on a patch of mixed clover, —consisting of red, Alsike and white—which was constantly visited by bees dur-

ing the flowering season. I noticed that a bee very seldom touched a head of the red clover, though it was the tallest and much the most attractive and brilliant, so far as color was concerned. There seemed to be but little difference in the number visiting the other two varieties; but when a bee began on either kind it continued on that till it had secured its load.

The conclusion to which I am led is that so far from the brilliancy of flowers being the only attraction of bees, they are but little, if at all, influenced by this consideration, but they are guided almost wholly by the presence of accessible nectar. How they first learned of its presence there I am not sure that I can tell, but most likely by the sense of smell. When, therefore, men assert, as above, and as Mr. Tyndall in his Belfast address, in giving the views of Mr. Darwin, tells us that "The beauty of flowers is due to natural selection, those that distinguish themselves by vividly contrasting colors from the surrounding green leaves, are most readily seen, most frequently visited by insects, most often fertilized and hence most favored by natural selection;" so far as the more frequent visits of insects is concerned, this grand scheme of "natural selection" exists only in the minds of these speculators.

But next let us inquire what dependence is to be placed in the statement that those plants having brilliantly colored flowers are more frequently fertilized and so more prolific than others. We might stop here and simply ask, are such plants more prolific than others? and leave those who make the affirmation to give us some evidence besides their simple statements. Is the hollyhock any more prolific than the chickweed that fertilizes itself before it opens its tiny petals? Is the sunflower more prolific or more able to hold its own in the "struggle for existence" than the sand-bur? Corn fertilizes itself by simply shedding the pollen from the tassel upon the silk without any insect agency. Wheat is generally fertilized before the stamens and pistils have protruded beyond the palæ of the chaff.

The fact is that the doctrine of insect agency in the fertilization of plants has been pushed too far—much farther than the facts will warrant.

Mr. Thomas Meehan, than whom there is none more competent to speak on this subject, after extended and repeated experiments for the express purpose of throwing light on this subject, draws the following conclusions: (1). "That the great bulk of colored flowering plants are self-fertilizers. (2). That only to a limited extent do insects aid fertilization. (3). Self-fertilizers are every way as healthy and vigorous, and are immensely more productive, than those dependent on insect aid. (4). That when plants are so dependent they are the worse fitted to engage in the struggle for life—the great underlying principle of natural selection." Where is there a more prolific seed-bearing plant than the lambs-quarter—*Chenopodium alba*—though both flowers and seeds are so inconspicuous as to be scarcely noticeable. Still another example is found in the Amaranth family which though very minute in both flower and seed is one of the most prolific weeds to be found in the country—often multiplying by tens of thousands. Let us turn now for a moment to the consideration of colored fruits, as

this is so intimately associated with the above that we can hardly separate them.

The same claim is set up for color in fruits as aids in their dispersion that we see has been made for it in flowers as aids to their fertilization.

Mr. Tyndall, as above, says: "Colored berries also readily attract the attention of birds and beasts, which feed upon them, spread their manured seeds abroad, thus giving the trees and shrubs possessing such berries a greater chance in the struggle for existence." Likewise Mr. G. Allen says: "Strawberries, raspberries, and blackberries, all belong to the class of attractive fruits. They survive in virtue of the attention paid to them by birds and small animals."

Of course then in the absence of these "birds and beasts," and "small animals" all these trees and shrubs would soon perish from the face of the earth. How then is it that those plants destitute of colored fruits manage to survive. How do maples and poplars and hundreds of other trees and shrubs that have no colored fruits survive? Why then do the potentilla still live, so like a strawberry in all except the enlarged, fleshy receptacle that we dignify with the name of "fruit." "Ay," says Mr. Allen, "there's the rub. Science cannot answer as yet." How then can it speak so confidently in regard to the strawberry?

Have these priests been into the secret chamber of nature and received a revelation of some of her secrets while others have been withheld? That these colored fruits do contribute somewhat to the dispersion of their seeds may be very consistently admitted; but that their existence is dependent on this, or that this gives them any special advantage, in the battle for life, over other species not thus favored may be as consistently denied. This is but one of several means employed by the Author of nature for the dispersion of seeds and the consequent dissemination of plants. One class is furnished with winged seed (samara) that cause them to be floated on the air to a considerable distance from the parent tree. The maple, ash, negundo, etc., are examples of this method. Another is furnished with a downy pappus that causes them to float in the air to a long distance at times. The dandelion, thistle, fire-weed, poplar, are illustrations of this. Still another method that I may mention is where the seeds are furnished with barbs or hooked spines by which they attach themselves to the clothing of persons or to the hairy or woolly coats of passing animals, and are thus carried to distant places and dropped, as in the case of burdock, cocklebur, beggar-lice, sand-bur, etc. Any of these methods furnished just as much assurance of the proper dispersion of seed to their species as do the colored fruits to those kinds producing them. The fact seems to be that the system of evolution sought to be built up and sustained by arguments drawn from the color of fruits and flowers, as above, is a speculative hypothesis based on suppositions and imaginings, bolstered up by doubtful analogies, and facts taken out of their true relations and explained by fanciful and forced interpretations.

CAÑON CITY, COLORADO.

PHYSICS.

REMARKABLE ELECTRICAL DISTURBANCES IN IDAHO TERRITORY.

D. A. WILLIAMS.

For the benefit of those interested in electrical science perhaps a few facts regarding the difficulties experienced in operating the telegraph lines of Idaho Territory may be useful, and possibly a remedy suggested by the scientific reader of the REVIEW.

On account of the dryness of the climate of Idaho Territory, it has been supposed no such difficulty as was experienced during the past summer would ever occur, but the practical telegraphers of the Oregon Short Line Railroad have met an obstacle, although it may not be insurmountable, is nevertheless very annoying, and new in telegraphic experience.

Twenty-five miles west of Pocatello the railroad and telegraph line crosses the Snake River just below its change of direction from west to almost due south. The road crosses the river directly over the American Falls, or Rapids, which it is thought by some develop or throw into the atmosphere, thence to the wire, a large amount of electricity.

The Snake River is not again seen from the railroad until a distance of one hundred and thirty-five miles is reached almost due west, thus the river courses around a great bend or elbow; when at King Hill it is again touched by the railroad but not crossed.

The writer was located at Shoshone, nearly midway between the American Falls and King Hill Station, which is also the junction of the Wood River Branch of the O. S. L. R. R., extending northward to the silver mines of Idaho. It was here that the writer had an excellent opportunity to observe the electrical disturbances as they occurred frequently between the months of May and October the past season.

When the telegraph wire had been extended as far west as King Hill we noticed whenever a storm-cloud appeared southwest (where they always appeared in summer,) there would occur a strange noise on the wire. At first the noise would be faint, but as the cloud (which to all appearances shed no rain, as rain seldom falls on the great lava plains of that district,) approached, following the course of the river, the peculiar humming noise would continue to increase until it became a roar, but more remarkable still, every "relay magnet" on the telegraph wire between the American Falls and King Hill would become useless and remain so until the storm had passed north of the American Falls. When the electric current was reversed, and the magnets would appear as in an open

circuit. Occasionally the circuit would as suddenly close, but the telegraphic characters heard were the reverse of the ordinary Morse Alphabet, and the wire would appear to be crossed with another wire, but which was not the case, there being but one wire on the road, which rendered crossing impossible without human agency.

The Snake River in its course performs nearly a half circle, and runs about twenty-five miles due south of Shoshone, but very few of these storms, or electrical clouds, ever passed directly over the town of Shoshone. In one or two instances late in the season, such was the case, however, and a fine shower accompanied the cloud, but all the effects of the overcharge (for that is what it seems to be writer to be) of electricity also accompanied it. In this case we thought the cloud had left the river at the Great Shoshone Falls, taking a northerly course until it spent its force in the Wood River Mountains.

During these storms several experiments were tried hoping to solve the mystery and provide a remedy, but without success. When the "ground wire" was attached to the telegraph wire at Shoshone, cutting off the west, for the purpose of getting rid of a portion of this foreign current, it was found the current was very much stronger, suggestive of a very heavy foreign battery in contact with the wire. As before stated, during the prevalence of these storms the magnetic current would become reversed; rendering all magnets on the line useless, between the points were the storm originated and where it again crossed the line, when the ground wire was applied to the wire as just mentioned, the magnetic current on a portion of the line would again assume its proper relation to the main batteries, but could not be used on account of the great increase of electricity, which would go and come at intervals of about five minutes. The ground wire was then applied to the east side of Shoshone, thus cutting off all battery from the west end of the wire, but the same state of affairs appeared, only there seemed to be a continuous metallic circuit, when for a time we would notice no humming noise, but the overcharge of electricity would be as strong as on the east side. This fact astonished us and could not be accounted for until it was discovered by the writer that his ground wire was not in the ground at all, neither had any on the line been put in the ground, but only attached to a "T" rail, or a box-car wheel (the same car being used as a telegraph office). The rails are laid with the patent "Fish Plate" joint, thus making an excellent conductor of electricity, and ordinarily the ground wire thus attached to the rail or wheel, made an excellent ground contact. These ground wires were afterwards placed in the ground with better results though by no means satisfactory to the telegraph department, it was found that during these storms the ground (this section is the gold bearing field of Idaho) was very heavily charged with electricity; we think the "cross" mentioned was thus accounted for, but how to account for the appearance of the reverse of a telegraphic alphabet of Morse characters on the wire is a question the writer would be glad to understand, it being also understood, of course, that at Pocatello where is located the dispatcher's office, the characters used were plain "Morse," while west of Amer-

ican Falls, until we reached Medberry west of King Hill, they were all reversed except when the storm-cloud had performed its circle; then an open circuit would occur between the stations mentioned, although the line was intact.

The coming of these peculiar storms could be foretold by tne strange humming noises, not like that made by the wind, but more like humming of bees, as we sometimes think we hear in a telephone receiver.

Taking off the main battery at Shoshone seemed to have but little effect upon the telegraph line during the prevalence of these storms. The relay magnets could not be adjusted to overcome these accumulations as is done in this section. When the main batteries were off the ground wires were on, showing the presence of an *earth current* as well as an *air* current on the wires.

There is possibly a solution of the difficulty in working of our telegraph wires during such an electrical display as we had last winter and spring. The writer has a theory regarding *earth currents* during these storms, and hopes at a future opportunity to demonstrate by actual experiment, that the "*earth wave*" is stronger than the "*air current*" as we have been led to believe during the auroral displays of our winter and spring.

It may be stated regarding the Idaho electrical storms, that there was no main battery on the telegraph wire west of Shoshone during the past summer, as the wire was in process of construction. There was also a slight escape of electricity from the wire through the "switch-board" to the lightning arrestor, but not as great as in an ordinary thunderstorm, such as we have witnessed at Kansas City and other cities in this section.

PHILOSOPHY.

SPHERAL EVOLUTION.

CHARLES MORRIS, PHILADELPHIA.

All the life and activity of the universe is dependent upon its effort to attain equilibrium of temperature. Yet its temperature inequality is only a temporary condition. A process of equilibration is in steady operation. When this reaches its ultimate result, and the temperature of the spheres and of space becomes everywhere equal, all life must cease, and general stagnation succeed the existing play of energy. Such is, briefly stated, the celebrated hypothesis of Sir William Thompson, according to which the universe is a wound-up clock, which is kept in motion by the gradual descent of high temperatures and ascent of all low ones, and which will run down when temperature becomes everywhere equal, and will thenceforward remain in eternal rest.

This hypothesis is not an agreeable one to contemplate, and many strenuous

efforts have been made to break the strength of the argument upon which it rests. But it must be admitted that these efforts have been, so far, futile, and that it is impossible to escape, with our present knowledge of physical laws, from the conclusion above enunciated. It is undeniable that every heated substance or sphere is losing its heat, that every cold substance or sphere is receiving heat from hotter sources and that all material activity is a result ofthis interchange. This process can have but one result, judging from the present standpoint of science. Heat equilibration and material stagnation must ensue. General rest and death must succeed the energy and activity which now give vitality to the universe.

If, however, we can, as yet, adduce no physical principle to annul the conclusions of this celebrated hypothesis, it cannot be declared that no such principle exists, since it is quite possible that we are ignorant of, or mistaken in regard to, many of the governing laws of nature. Facts always have the precedence of theories, and there are certain facts which seem irreconcilable with the hypothesis referred to. As it has never yet been considered, so far as we are aware, in the light of these facts, we propose to adduce them here, as an illustrative argument against its conclusions, where all logical arguments have failed.

As to the primary condition of the universe two theories exist. It either began its existence at some definite period, in response to a creative fiat; or it has existed from eternity, and has during infinite time been subject to the same laws which now control it. If the latter view is accepted the stagnation hypothesis at once goes by the board. A clock whose motion is not perpetual, and which began to run down at an infinite period in the past, must have come to rest infinite ages ago.

If, however, the universe commenced its existence at some finite period in the past, its present activity is perfectly compatible with a movement towards final stagnation. We cannot deduce from the conditions of the stellar universe which hypothesis of "the beginning" is the correct one. But these conditions may lead us to some conclusion as to the probable course of stellar evolution.

We know that all stellar evolution has been a process of material condensation and integration. Diffused matter has gathered into nebular masses. These have condensed into solar nebulæ, and the latter into suns with attendant planets. Many of the planets have cooled off and solidified superficially, and in some cases perhaps completely. Suns have also cooled, and in many cases may have lost their luminousness.

The visible universe presents instances of this whole range of gradations. There are distinguishable in the skies stellar masses of many degrees of luminosity. Some indicate in the spectroscope an intensely heated condition. Others appear much less heated. Some have grown comparatively cool. Others, as the companion of Sirius, are but faintly luminous. Still others, as the companion of Procyon, have lost all visible light-giving powers. That there are dark suns which have cooled far below the luminous stage cannot be proved, but is quite within the range of probability.

On the other hand numerous stellar bodies exist which have not yet attained

the solar state. Nebulous masses are visible whose variety of conditions is yet greater than that shown by suns. From a stage in which they are little short of solar condensation they can be traced through greater and greater degrees of rarefaction until they become dim and shapeless whiffs of light-yielding matter, that seem but just blown together out of the homogeneous gas of space.

This represents what we can see. The telescope unfolds an extraordinary range of stellar evolution, from the just visible and utterly shapeless nebula, to the sun which has almost cooled into darkness. That we see all that exists it would be idle and probably false to affirm. We have one or two indications of the existence of dark suns, and it is quite possible that thousands of such exist, many of which may have grown non-luminous untold millions of years ago. At the other end of the series it is all but certain that nebulæ exist too faint to be resolved by our telescopes. Millions of others may exist which are in a far less evolved condition than those we see. We can behold in space the line of stellar evolution, yet existant in examples of nearly its every stage, from the faint nebula to the darkening sun. The scope of logical deduction carries our vision still further, and adds to the extent of this line at both its ends. Such is the existant condition of the material universe, as revealed to us in the depths of space. Must conclusion arise from this condition? This is the problem which we have now to consider.

If the universe was created at some definite period, with its existing laws of material evolution, it must have begun its existence either as homogeneously diffused matter, or as matter partly diffused and partly aggregated into masses. If it is to be finite in duration, and end at length in irreversible stagnation, the latter method of creation must be the true one. Unless there is some reversing agency at work it is impossible to understand the extraordinary diversity of conditions of aggregation in the stellar universe, except on the hypothesis of a creation in these diverse conditions.

It is true that there is a great difference in the rapidity of condensation of stellar masses, in accordance with their difference in size. If we compare the Moon, the Earth, Jupiter, and the Sun, we have four spheres, whose evolution began simultaneously, which are now widely different in degree of condensation. It is quite possible that a great number of spheres, which began to condense simultaneously, might, after many millions of years, present a great diversity of conditions, if they were greatly diverse in original size. But this idea will not explain the diversity of the stellar masses, in which there is no reason to believe that degree of condensation is accordant with difference in bulk, or that the fainter nebulæ could have begun their evolution simultaneously with the larger and cooler suns. The indications, indeed, point strongly towards a successive beginning of condensation in many of the visible masses. This is strengthened by the fact that the nebulæ are not scattered indiscriminately among the suns, but are mainly grouped in a region of space by themselves, as if a secondary and much later creation had taken place in this region.

We seem thus forced toward the alternative of a heterogeneous creation.

Here a solar sphere was called into existence, there a nebula, there a mass of diffused matter, destined to become condensed into nebulæ and suns. We can not well reach any other conclusion from the facts, if we accept the theory that the process of stellar evolution is an irreversible one, and that the universe is moving steadily onward towards a condition of eternal stagnation.

And yet, if a logical examination is made of this hypothesis of original heterogeneity, it can scarcely be sustained, since it requires a method of creation that is so improbable as to be barely conceivable. It tells us that some of the solar orbs were called into existence in a mature or nearly mature stage, others were born immature, and others left to evolve from their germinal condition. This would be to affirm that stellar creation was here direct, here partly indirect, and here completely indirect. It would be synonymous with the affirmation that both direct creation and evolution are true of the animal world, some species being called into existence by a direct creative fiat, others created in embryo and left to attain maturity by development, and others evolved by natural processes from inorganic nature. Whatever theory of animal development be accepted it will certainly be no such double hypothesis as this. Nor can we safely affirm any such double process of stellar development or origin.

The only direct evidence we possess of the method of stellar development is that displayed to us in the geological history of the earth. We are fully satisfied that the earth has developed from a far less mature condition to its present state. And the facts in favor of the nebular hypothesis are less positive proof of an evolution from a nebulous mass to the present conditions of the solar spheres. The testimony of the stellar masses of space adds to the strength of this evidence, and points to nebulous masses yet seemingly in their primitive stage, while we are to some extent justified in imagining others which have in comparatively recent times begun their condensation.

From these various reasons we can scarcely avoid the belief that evolution from diffused matter has been the history of every sphere of space, and that the great range of conditions between the embryo and the mature stages now existing are positive evidence that the present condition of the universe does not represent that of the original creation. The evidence of the spheres is strongly in favor of an evolution of them all from a primitive germinal stage, and of some reversing principle which will, and has frequently in the past, overcome the tendency to temperature equilibrium and stagnation, and reduced mature spheres to their primitive stage of diffused matter.

If we can imagine a period in which all the material of the present universe was spread through space in a diffused condition of partial or complete homogeneity, there seems but one conclusion. Spheral evolution, under the influence of gravitation, must have everywhere at once begun. All the matter capable of condensing would have gathered into nebulæ, leaving the remaining matter in a state of excessive rarity. These nebulæ would have become spheres, and finally only spheres of various degrees of condensation, with intervening rare matter,

would have existed. If the process was irreversible this condensation must have gone on, until final stagnation was reached.

Yet the record of the skies tells a different story, since it speaks of spheres which are hoary with their weight of ages, and of numerous other masses which have but recently drawn together out of the matter of space. Whence came the latter? It is impossible to conceive that they delayed the commencement of their evolution until after other spheres had gained their mature stage, nor can we imagine that the diffused matter left from the first period of evolution was sufficient in quantity and suitable in condition to set in train such an extensive second evolution as the story of the nebulæ indicates.

The facts strongly favor some reversal of the original process, and indicate that these new-forming nebulæ are built up from the diffused material of spheres which had gained the ultimate phase of their condensation, and then through the operation of some energy, of whose character and whose laws of action we are ignorant, reversed their condensing process and become again dispersed as diffused matter through space. In this manner the requisite substance for a new process of nebular and spheral evolution would be provided. Whether such a dispersal of the matter of older spheres, if it took place, did so immediately, through some grand disrupting convulsion, or gradually, through some slow and unavoidable reversal of the processes of natural energy, is of course beyond the reach of conjecture. But it can be affirmed with some reason that the conditions of matter visible in the depths of space, and the logical conclusions as to the conditions of invisible matter, indicate that the universe is not a clock which is destined to run down and end in eternal cessation of life and motion, but a self-winding clock, a perpetual-motion time-piece of eternity, which can never cease to run, but whose springs of motion, when they have almost lost their force, shall again, through some natural law, as yet unknown to us, regain their primitive energy, and again set the wheels of evolution in play with all their pristine force.

ARCHÆOLOGY.

A MONSTER MASTODON.

Mr. Herschfelder, American Vice Consul here, and a well-kown archæologist, was fortunate enough to secure some stone tablets with well defined hieroglyphics from Muskoka. He had scarcely settled himself down to business again when he was off on another expedition, this time to a place in the vicinity of Woodstock, where he has been digging and delving for the past four or five days. The story of his expedition is an interesting one. Twelve years ago, while some laborers were engaged in digging a drain on the farm of George Crumble, about five miles east of Woodstock, and in the township and county of Oxford, one of

them met with an obstruction which he smashed with his spade and pitched to one side. It turned out to be a bone belonging to some gigantic animal, but nothing further was thought of it and the matter was forgotten. About two years ago it was decided to tile drain the same field, and in clearing out the old drain other bones were found. An enterprising individual by the name of Carter secured them, and after cleaning, varnishing, and duly labeling the relics, proceeded to exhibit them at so much a head, for the benefit of the rising generation. Mr. Herschfelder came to hear of them, and after paying a good round sum secured the bones. Another payment secured the right to dig over Crumble's field, in which they were found. A gang of men were at once set to work. A ditch 75 feet long, 40 feet wide and four feet deep was dug, and the enthusiastic archæologist was rewarded by finding fully one-half of the bones of a gigantic mastodon. It is needless to say they were very carefully taken from their resting place and boxed up for shipment to Toronto. They are in a remarkably good state of preservation, and their situation rendered the task of exhuming them one of comparative ease. The surface soil consists of a light sand, under which is a layer of decaying vegetable matter. Under this again is a harder layer of decaying vegetable mold; then comes a soft, yellowish-colored clay, and last the hard blue clay in which the remains were found, the latter being only about four feet below the surface. So far as known at present these are the first remains of the kind ever discovered in Canada. To give an idea of the huge proportions of this monster, whose race was extinct long before antiquity had begun, a few measurements of some of the bones which Mr. Herschfelder brought back with him are given. Several of the ribs measure 44 inches long by about 12 in circumference. The lower jaw is no less than 30 inches long, and must have weighed, in the living animal, upwards of 150 pounds. The surface of one of the teeth is 7 inches long by 3½ wide, while the root is buried over 4 inches in the jaw. One vertebra measures 17 inches in length, and one of the bones of the fore leg 30 inches long by 24 inches in circumference. Mr. Herschfelder thinks he has fully one-half of the skeleton, and expects to get more.

The mastodon is an extinct proboscidian mammal, coming near the elephant, and either in the tertiary or more recent deposits in all quarters of the globe, except Africa. It has the vaulted and cellular skull of the elephant, with large tusks in the upper jaw. From the character of the nasal bones and the shortness of the head and neck it is thought that, like the elephant, it had a trunk. A few remains of the mastodon had been discovered in the United States as early as 1705, but not until 1801 was anything like a complete skeleton obtained, when a tolerably complete one was found in Orange County, New York.

The geological position of the remains of this species has long been and still is a subject of dispute amongst geologists. In a few instances they are said to have been found below the drift in the pliocene and even in the miocene, but they have generally been obtained from the post-pliocene or alluvial formations at a depth of from five to ten feet. Some have thought that the mastodons be-

came extinct since the advent of man upon the earth, like the dinornes and the dodo. According to Lyell the period of their destruction, though geologically modern, must have been many thousand years ago. According to Owen the mastodons were elephants, with molars less complex in structure and adapted for coarser vegetable food, ranging in time from the miocene to the upper pliocene, and in space throughout the tropical and temperate latitudes. The transition from the mastodon to the elephant type of dentition is very gradual.—*Toronto Mail.*

THE AGE OF THE WORLD.

W. M. PAGE.

According to the reckoning of our Jewish fellow-citizens, who are at this time celebrating their religious festivals on account of their New Year Day of Atonement, and Feast of Tabernacles, it is from the creation of Adam to the present time 5,644 years.

	YEARS.
The Seder Olam Lutha makes it	6,243
The Eastern Jews	6,104
The Western Jews	6,068
The Chinese Jews	5,963
The Seder Olam Rabba	5,635
Rabbi Gershom	5,638
Rabbi Habsom	5,624
Rabbi Nosen	5,618
Rabbi Hillel	5,584

To the above ten Jewish authorities we add below five Christian authorities:

	YEARS.
Joseph Scaliger	5,833
Petan or Petavius	5,867
Usher (generally found in our Bibles)	5,887
Mursham	5,883
Isaac Newton	5,871
To the above I add my own	6,992

It will be seen that of the above sixteen authorities, no two of them agree.

It will be seen that my own calculation makes the age of the world more than 1,000 years longer than any of the above Christian writers, and 1,348 years longer than the date of our Jewish fellow-citizens, who are now celebrating their festivals. The learned writer of "Ordo Sæclorum" writes: "That the chronology of the Scripture history, both as a whole and in many of its details, is involved in much uncertainty no one who has given any heed to this subject can fail to be aware. Even in the New Testament, enclosed as it is in a richly his-

torical era, the learned have never been able to agree upon the precise dates of its cardinal events; while in the Old Testament the authority of distinguished names is evenly balanced between schemes which, besides a multitude of minor discrepancies, vary in their large ranges by many centuries of difference. And, when one looks beyond mere tables, and considers the vast amount of learning and thought which must have been bestowed upon their construction, it is natural to infer from the wide discrepances of the results, that the elements of the problem must needs be very ambiguous or defective. Accordingly the subject is commonly pronounced to be one on which further inquiry is not only vain —since, if certainty were to be had, the question would have been settled long ago—but presumptuous too; for does it not betray an overweening temper to think of making discoveries in a matter which men of consummate learning have failed to bring to a satisfactory adjustment?" Introduction, page 1, sec. 1.

"When we survey the strange variety and discordance of the several systems of chronology, scarcely two of them agreeing, even in their fundamental dates, and all differing from each other more or less in the principles of their construction, and in the application of those principles, sometimes adjusting sacred chronology by profane and sometimes the reverse, without any settled rule or standard, we may naturally be led to despair of any solid or scientific improvement of the subject, especially at this advanced season, after the failure of so many of the greatest scholars, historians, mathematicians and astronomers, when no fresh documents can be expected, and when many valuable records to which the earlier chronologers had access are now lost and swallowed up in the abyss of time. A modern chronologer discloses: 'It is easy to pull down the system of chronologers; it is by no means so to build up in their room one that can support itself against all difficulties; I do not even believe it possible,' Sarcher, Herodite, Tom. 1, page 309, 1st edition. It is indeed 'easy to pull down,' as may appear from the foregoing section; but 'to bui'd up' is most difficult." Hale's Analysis of Chronology, vol. 1, page 265.

I have given the above quotations to show that I have undertaken no easy task, when I attempt to establish the true time which has elapsed from the date of the creation of Adam to the present time. All we can know of the past is from what has been recorded by those who have lived in the past. In regard to the date of the creation of Adam, the Hebrew writings are almost our sole reliance; indeed, with the exception of the Sothiac, or rather Sethic cycle, which crosses the Hebrew narrative at two essential points—the Exode and the Flood—we have no other record but the Bible to assist us in building up a true chronology from Adam to the present time. It may be well at the outset of this investigation to inform the reader that the Bible, in whole or in part, has been preserved to us in three different languages—namely, in Hebrew, Samaritan and Greek, and also that scholars differ very widely in their calculations. As they form their chronological tables from one or the other of these authorities, this difference arises partly from the mistakes of copyists and translators and partly from the wilful corruption of the text. We now place before the reader the

chronology of each of these versions, from Adam to Abraham, and give our own opinion supported by the Sethic, and also by the Sabbatical and Jubilean cycles.

THE AGE OF	HEB.	SAM.	SEPT.	TRUE.
Adam at the birth of Seth	130	130	230	130
Seth at the birth of Enos	105	105	205	105
Enos at the birth of Canaan	90	90	190	190
Canaan at the birth of Malaled	70	70	170	170
Malaled at the birth of Jared	65	65	165	165
Jared at the birth of Enoch	162	62	162	162
Enoch at the birth of Methuselah	65	65	165	165
Methuselah at the birth of Lamech	187	67	187	187
Lamech at the birth of Noah	182	53	188	188
Noah at the Flood	600	600	600	600
Date of the Flood	1656	1307	2262	2062
The Flood lasted one year	1	1	1	1
Arphaxed born after the Flood	2	2	2	2
THE AGE OF				
Arphaxed at the birth of Sulah	35	135	135	135
Sulah at the birth of Eber	30	130	130	130
Eber at the birth of Phaleg	34	134	134	134
Phaleg at the birth of Ragan	30	130	130	130
Ragan at the birth of Serny	32	132	132	132
Serny at the birth of Nahor	30	130	130	130
Nahor at the birth of Terah	29	79	79	79
Terah at the birth of Abraham	70	70	70	70
Date of birth of Abraham	1949	2250	3205	3005
From the birth of Abraham to the Promise	..	..	..	85
From the Promise to Exodus	..	..	..	430
From Exodus to Vulgar Era	..	..	..	1590
From Vulgar Era to 1883, A. D	..	..	..	1882
From Adam to A. D., 1883	..	..	..	6992
From A. D., 1883 to 7000 from Adam	..	..	..	8
From Adam to the year A. D., 1890	..	..	..	7000

The flood according to Egyptian authorities took place on the 17th day of the third month of the vague year; and according to the Hebrew Bible on the 17th day of the second month; now, in the year A. D. 3048 (which is equal to year A. M. 2062) the 17th day of the Egyptian third month of the vague year fell on the same day as the 17th day of the Hebrew second month; as also did the 1st day of the seventh month of the Egyptian vague year fall on the same

day as the 1st day of Nison of the Hebrew year in B. C. 1590. And this is further confirmed by the Jewish cycles of the Sabbatical and Jubilean years.

Jesus commenced his ministry in a Jubilean year; see Luke iv, 16-19, and this year was the 15th of Tiberius Cæsar or A. D. 29. The Jubilean cycle was a cycle of forty-nine years, and if the Exode took place in B. C. 1590 then the first Jubilean year was B. C. 1540, the thirty-second Jubilee was in A. D. 29, and the seventieth Jubilee, which also is the Great Jubilee, will commence with the Jewish new year A. D. 1890, before which time, I predict, the Jews will be masters in Jerusalem, for the time of Gentile rule over the Holy City will have ended.

I base the above predictions on the words of the Prophet Daniel, chapter 9, verse 11. The curse there spoken of must relate to their chastisement "seven times" for their sins. Seven prophetic times are equal to 365 years multiplied by seven, equal to 2,555 years of punishment for sins. The beginning of this period must have been when Esarhaddon invaded Palestine, carried the ten tribes into captivity and sent Manasseh, King of Judah, a prisoner in chains, to Babylon, all of which took place in B. C. 670. And if the beginning of the "seven times," or 2,555 years of captivity, commenced B. C. 670, they will end in A. D. 1886, at which date the "times of the Gentiles" will end and Jerusalem will be once more under Jewish rule. But if a Jubilean year will commence in September, 1890, a Sabbatical year will commence in September, 1889, and if so, then a Sabbatical year has just ended at the commencement of the present Jewish New Year—or, to speak more correctly, it ended just one Jewish month earlier, for the Jews, following the 19-year cycle, are just one month out of line this year, with all their feasts and festivals, while last year they held them correctly. This mistake has happened to them on account of their adoption of the Gentile method of regulating and bringing into harmony their lunar, with the true solar year, instead of following the more correct mode of their fathers. In other words they made the last year a leap year of thirteen months, when, according to the usage of their fathers, it would have been an ordinary year of twelve months, for they always commenced their religious or ecclesiastical year with that moon whose 15th day would happen after the sun had entered Aries. By following this rule their festivals would always be held by them at the proper time, instead of, as is the case this year, one month out of line with the true time for holding them.

If the reader will verify for himself that I have given the true date when the Egyptian vague year crossed the Hebrew year, he will then be sure that the date of the Exode was B. C. 1590, and the date of the Flood B. C. 3048. It will follow that the first Jubilean cycle was in B. C. 1540, and the seventieth Jubilean cycle will commence September, 1890, or 7,000 years from Adam.

In conclusion, there has been much said of late of Egyptian records running back into a very remote antiquity. It is fortunate that the Egyptians made an observation of the planetary configuration at the time of Menes' arrival in Egypt,

and that it has been preserved for us on their temples and in their sacred writings even to the present day. We are at present already acquainted with sixteen temples and monuments, which exhibit a representation of this very planetary configuration of Menes. On the majority of them the ancient Menes stands opposite to the row of the gods, his only garment being a tiger skin; on others his person and his name are expressed by means of the crescent ☽ i. e., the letters M N or Menes. The most concise expression of this planetary constellation is to be found on the Osimandyeum near Karnak from the year 1700 B. C. For a copy of this astronomical inscription and its explanation, see my "Berichtigungen der alten Geschichte," page 198. Each of the seven planetary gods is seated in a chair, together with one of the twelve gods in whose sign the planet happened to stand at the time. We find the sun in Cancer 0°, the moon in Scorpio, Saturn in Sagittarius, Jupiter in Aries, Mars in Sagittarius 10°, Venus in Cancer 10°, Mercury in Cancer 5°. This planetary configuration, which has occurred but once in history, has reference to the year 2781 B C. to the 16th day of the Julian July."—[Seyfarth's Chronology, page 94.

Thus we find that Menes entered Egypt 267 years after the flood, and we learn from Lyncellus that the shepherd kings conquered Egypt in 701st year of a sothiac cycle, or in the year B. C. 1670. The Israelites entered Egypt during their occupancy of the land, and were welcomed by them in B. C. 1805. When another king arose who knew not Joseph in B. C. 1670, the Israelites were enslaved for a period of eighty years, and were released by Moses in B. C. 1590. —*Globe-Democrat.*

ANCIENT RACES OF THE MISSISSIPPI VALLEY.

At the last meeting of the Chautauqua Circle, at St. Louis, Major F. F. Hilder delivered a lecture upon "The Ancient Races of the Mississippi Valley," but most of his attention was devoted to the remains discovered in southeast Missouri. It is in that part of this State the greatest number of well-preserved relics are found, and his collection embraces many valuable finds of this region. The most curious were used in illustration, particularly of his theory that there are not only connecting links between the mound-builders of this country and the ancient Asiatic people in their customs, but also that their languages were similar. The religion of the mound-builders was sun-worship, and traces are found in every mound uncovered of their ceremonies and rites in this worship. The pottery found among the dust of their chiefs and rulers bear signs and symbols peculiar to this religion in every nation of the world where it is practiced. He had but recently, with Prof. Campbell, succeeded in deciphering the inscription on a tablet which showed there were words of their language exactly like those of ancient Asiatic languages, and in some instances found in other forms in modern tongues. A vase found within six miles of Charleston, this State, he described minutely in a letter to Schliemann who was at that time before Troy

digging for the relics of the Hellenic race. In reply Schliemann said his statements had been received with wonder, so nearly allied were all the characteristics he had mentioned, to ware found by him in his diggings. The position of the vase had been such as to warrant the belief that it had been buried 1,000 years.

ASTRONOMY.

GLOWING SKIES OF NOVEMBER AND DECEMBER, 1883.

The peculiar glowing appearance of the morning and evening sky since about the middle of November has aroused much scientific and popular curiosity all over the world, and we have received numerous letters and personal inquiries concerning it. For the purpose of giving our readers all the information possible upon the subject, we present herewith a letter from Prof. C. W. Pritchett, of Morrison Observatory, and also extracts from several articles that have appeared in our exchanges.—[ED. REVIEW.

MORRISON OBSERVATORY, GLASGOW, MO., Dec. 17, 1883.

EDITOR REVIEW.—For several weeks I have watched with much interest the special phenomenon referred to in the extracts you sent me. Its *persistence*, *intensity* and *duration*, have alike claimed my attention. On some evenings and mornings the appearance has not only been gorgeous but even startling. On the evening of December 14th, while observing the Comet Pons-Brooks in the northwestern sky, this red glow could be distinguished in the field of the telescope, as late as 6h. 30m. Valley Time. Investigations of the *causes* of the phenomenon, belong in part to meteorology, and in part to meteoric astronomy. In neither of these fields of inquiry am I an amateur. I can only subjoin a few notes, from my own observations.

I think it evident, that the phenomenon is due to some attenuated form of matter in the upper regions of the atmosphere. This granted, the question arises, *What* and *when?* We can scarcely think it is vapor, whose particles are so light and dispersive that they cannot be condensed into clouds; for the sky has been unusually free even from "haze," for days and nights together. Again, granting the existence of such masses of unrecognized vapor in our atmosphere, they would be local, or at least confined to certain zones of the earth. This phenomenon, however, has been widely observed over all North America and in Europe. Again, vapor in the attenuated form could not persist so long, nor could it have the *refractive* and *reflective power*, which morning after morning, and evening after evening it has revealed to the most casual observer. That these particles are at a *great height*, is evident from the fact that the glow frequently extended all around the horizon, to an altitude of 45°, and on several evenings it reached

to the zenith—and all this in a sky perfectly cloudless, for days and nights in succession. One marked feature, which I have noted, has been a zone of *intense blue*, about 35° above the horizon, and most conspicuous directly over the place of the Sun, both morning and evening. Directly above this zone, and opposite the Sun, appeared a gathering darkness, in a pyramidal shape, with base toward the Sun. Nor has this last appearance been confined to twilight. I have had occasion on a number of the fine days of the last few weeks to observe the bright star Alpha Lyræ, when on the meridian, the culmination usually occurring about 2 o'clock of Valley Time. On two of these evenings, looking up, vertically, into the cloudless heaven, from the darkened transit-room, through the slit in the roof, this *same condensation* was obvious, following the Sun—as if there were myriads of faintly illumined and minute bodies in the upper atmosphere The *conjecture* that this phenomenon is due to the presence of "meteoric dust" in the upper regions of air, is *not to be despised.* That the Earth's orbit intercepts various meteor streams is a well known fact in astronomy. It is *possible* that we may have passed through such a stream in daylight, and have only the slowly descending ashes of countless myriads of "shooting stars" to remind us of the fact. It is reported that explorers in the Himalayas have recently found on the ice and show, far from any human habitation, large deposits of this ferruginous dust. It has sometimes settled down on ships, far out at sea, and must either have come from the "upper depths," or else have been borne by wind currents hundreds of miles from distant volcanoes. But this whole subject needs numerous accurate observations and much patient investigation.

C. W. PRITCHETT.

Professor Brooks, of the Red House Observatory, while searching for a comet near the Sun, November 28th, discovered a wonderful shower of telescopic meteors, some of which were moving southward and others northward. Prof. Brooks believes that this display has some connection with the remarkable red light seen near the sun at sunrise and sunset for several days, and that the earth is passing through a mass of meteoric dust or is enveloped in the tail of a gigantic comet.

The *Scientific American*, noticing Professor Brooks' theory that it was caused by "swarms of meteors" in the upper sky, which the professor saw while looking tor a comet, says:

Assuming, then, that he really did see an extraordinary swarm of meteors, and remembering that meteors large enough to be visible without telescopes, and some of great size and brilliancy, have recently been unusually numerous, the suggestion that the red light seen in the sky for several evenings past, long after sunset, may be caused by reflection from clouds of meteoric dust in the upper portion of the atmosphere is not unnatural. There are several reasons for thinking that the strange light is the result of some such cause as the presence of

meteoric dust rather than of differences of density in the atmosphere leading to extraordinary refraction.

In the first place the phenomenon has not only been visible over an immense extent of territory, but it has lasted several days, and has been seen in the east before sunrise, as well as in the west after sunset, so that any abnormal refraction in the atmosphere would have to be of almost incredible persistence in order to account for the observed appearances. Besides, during this time there have been considerable atmospheric changes, especially in respect to temperature. These remarkable sunset displays have also been accompanied by a notably hazy appearance of the sky.

It is well known that the earth is daily and nightly pelted with millions of meteors, the vast majority of which are almost instantly consumed by the intense heat developed as they dash into our atmosphere. The products of the combustion of these meteors filter slowly down through the air, and have been found in the shape of metallic dust on the snow fields in the Arctic regions, on mountain peaks in Europe and in other similar localities, being recognizable by their peculiar chemical composition. It is also known that the solar system abounds with swarms of meteors revolving around the Sun, and that the earth crosses the path of a number of these, occasionally encountering the swarms themselves. The vast majority of these meteors are very small, those that are seen weighing on an average probably only a few grains; and since the telescope reveals millions which escape the naked eye, it is reasonable to conclude that millions more are too small to be seen with telescopes—mere meteoric dust. Professor Brook's suggestion that the earth has encountered a cloud of meteoric dust is not, therefore, without foundation in probability. If the recent blazing sunsets have really resulted from such a cause, they are likely to continue, in a modified form, for some time, gradually disappearing as the dust sinks lower in the atmosphere. But although so many reasons can be advanced which give probability to the theory that meteoric dust is concerned in the production of these strange sunset effects, yet it cannot be considered as proved, and some better explanation may be offered. Whatever the true explanation may turn out to be, however, everybody seems to agree in the opinion that the red glare in the west during the last three or four evenings has been one of the most singular spectacles beheld in the sky for many years.

At a meeting of the American Astronomical Society, in New York, a few days ago, three theories were advanced. One would have it that the brilliant redness in the evening sky was caused by reflection from banks of clouds below the horizon. Another held that the curious appearance was produced by the passage of the sun's rays through strata of the atmosphere heavily laden with moisture, which absorbed the violet elements, but let the red go on. According to the third notion, which is that most generally accepted, the earth has just penetrated vast clouds of meteoric dust, which occasioned the phenomenon.

Within the last two weeks the strange red glow in the sky after sunset and before sunrise which attracted so much attention here last week has been witnessed across the whole North American continent, from California to Maine. The phenomenon seems to have been first seen on the Pacific coast on the evening of November 20th; and in San Francisco, just as in New York, a week later, people believed that the light was due to a great conflagration. It is a curious fact that while the dates of the appearance of this phenomenon at different places in the United States are such as to suggest that it advanced from west to east across the continent, it was seen in England as early as November 9th. The various descriptions given leaves no doubt that the strange illuminations beheld in England were of the same nature as those witnessed here. Besides, although the most conspicuous feature of the display here was the red color of the heavens, yet other peculiar optical effects were perceived which suggest a close resemblance in many respects between this phenomenon and the green sun and its accompanying appearances, seen in India and South America in September. The explanation offered of the strange color of the sky in India, namely, that it was caused by vapors emitted by the Javan volcanoes in their great eruption at the end of August, seemed reasonable enough; but there were great difficulties in the way of the acceptance of the same explanation of the South American phenomenon, one of the chief of which was the fact that the Sun appeared green in South America before it did in India. Nevertheless, the phenomena in the two countries were so similar that it was natural to ascribe them to a similar origin, and evidences of a volcanic outburst in South America like that in Java were sought for. But it now appears that no such disturbance has occurred in South America.

The likeness between the recent sunset and sunrise phenomena here and the appearances in South America and India just described also suggests a common, or at least a similar, cause. The suggestion that this cause may be the presence of meteoric dust in the atmosphere seems to fit all the circumstances better than any explanation yet offered, although it, too, encounters difficulties. The earth has within the last three weeks crossed the tracks of two meteor streams, and the number of brilliant meteors seen recently has been such as to attract special attention from observers of the heavens. These meteors have nearly all left long trails in their flight, and the latest investigations show that these meteor trails are only incandescent dust or vapor, like that into which the meteors themselves are entirely converted unless, as occasionally happens, they strike the earth before being completely consumed. On Thursday night a very remarkable meteor of this kind was seen in this city, and the observation by Professor Brooks on Wednesday evening of a wonderful shower of telescopic meteors adds to the mass of evidence that the earth has just been passing through a region rich in these cosmic particles, which, falling under its attraction, have plunged into the atmosphere in great numbers.

The suggestion has also been offered that the supposed meteoric matter may be the debris of the famous comet of Biela, which many years ago split in two and

afterwards disappeared, leaving no trace of itself except a brilliant swarm of meteors, which came dashing out of the northern sky on the track of the lost comet in 1872. The earth crossed the orbit of this comet, which is believed to have been converted into a mass of meteors, on last Tuesday, the very day on which the most brilliant sunset spectacle was beheld here. At first sight this coincidence in time seems to lend strong support to the suggestion that the remains of Biela's comet furnished the meteoric matter from which the sun's rays were reflected in the higher regions of the atmosphere. But the apparent confirmation disappears when it is recollected that in California the same appearance was presented a week, and in England more than two weeks, before the earth reached the comet's path. Moreover, the meteors seen by Prof. Brooks, and those which for several weeks have attracted attention both in this country and in Europe, did not belong to the Biela swarm, which always approaches from a particular point in the northern heavens. It appears, then, that if an unusual quantity of meteoric dust has recently entered our atmosphere from outer space, it has come, not from any one of the several swarms of meteors which make their appearance at regular intervals, but from meteors which the earth does not regularly encounter, or perhaps from a cloud of mere cosmic dust.

Soon after the comet of 1812 was detected returning sunward last September, it exhibited a wonderful outburst of light, accompanied by an equally surprising and sudden increase of size. Later it faded again, and since then it has behaved in a normal manner, and is now just visible to the naked eye approaching the Sun. The appearances it presented in September suggested that it had had a collision with some other body, producing a sudden flare of light and expansion of volume, owing to the heat developed. In view of the evidence that the region of space through which the earth is now advancing abounds in meteoric masses, it is a curious question whether, if the comet had a collision, it did not run into a swarm of meteors.—*N. Y. Sun.*

DISCOVERY OF ASTEROID PALISA (235).

A cable dispatch has received last night, at Harvard College Observatory, announcing the discovery of a small planet, by Palisa, at Vienna. Its position was

Greenwich M. T.			R. A.			Decl.		
	H.	M.	H.	M.	S.	°	′	″
1883. November 28.	13	20	3	19	14	+ 15	52	17

Daily motion in R. A. —48s.; in Declination 0. It is of the twelfth magnitude.

The planet was readily identified at Harvard College Observatory, and was observed by Mr. Wendell, as follows:

Cambridge M. T.			R. A.			Decl.	
	H.	M.	H.	M.	S.	°	′
November 30.	9	30	3	17	27	+ 15	51.1

—*Science Observer Special Circular No. 42.*

SUN AND PLANETS FOR JANUARY, 1884.

W. DAWSON, SPICELAND, IND.

On January 1st it has been ten days since the Sun passed Winter Solstice, where his R. A. was 18 hours. Increasing in R. A. at the rate of about four minutes a day, brings him on the 1st of January at noon to 18h. 47m.; and having declined northward nearly half a degree, makes his declination 23° 1′ S. He runs northward 5½° during the month, being in south declination 17° 24′ on the 31st; and R. A. 20h. 55m., on the last noon of the month. On the 1st, Sun is slow of M. T. by 3m. 44s. So, when he is on the meridian (exactly south) it is 12h. 3m. 45s. by mean or clock time, which is the right time to use in the common affairs of life. The least number of sun-spots observed during the past month is 12, on December 5th; the greatest number is 120, on December 12th.

Mercury is Evening Star till January 20th. It will be farthest east and best seen on the 4th, being then about half an hour below Venus, which is very bright. Both planets set a little north of where the Sun does. Mars rises on January 1st about 8 o'clock in the evening; and at 5 o'clock on the 31st. This planet retrogrades—goes backward, or east, among the stars—from R. A. 9h. 40. to 9h. 4m. during January. It is a few degrees northwesterly from Regulus, in Leo. Jupiter rises soon after 6 P. M. in the fore part of the month, and will be splendid for observation all winter. He will be in opposition to the Sun January 19th. Jupiter and Saturn are also retrograding very slowly. Saturn rises soon after 2 P. M. on the 1st, and of course, is three or four hours high at dark. It still holds its place a few degrees above and to the left of Aldebaran in Taurus. This is a worthy object for the telescope. The Moon will pass through between it and Aldebaran soon after midnight January 8th. Uranus is now in Virgo, nearly between the stars Beta and Eta of this constellation. Neptune is on the confines of Aries and Taurus, about 10° southwest of the Pleiades.

ARTS AND MANUFACTURES.

ON THE MANUFACTURE AND DURABILITY OF ROOFING-SLATE.

E. H. S. BAILEY, PH.D.

Slates suitable for working are found associated with many metamorphic rocks, especially those of the Silurian period. They are closely related to micaceous rocks and often graduate into them. That the lamination or slaty cleavage was produced by lateral pressure, and that, not at the time of bedding of the

rock but afterwards seems to be abundantly proved. This pressure was frequently applied at right angles to the line of bedding. Wax and other plastic material can be made laminar in structure by means of lateral pressure. And Tyndall has shown that the same thing takes place in the ice of glaciers, at points where it is subjected to immense pressure, as at a narrow part of the valley. In the case of a slaty rock the clay might become laminated, while sand or limestone associated with it might show no such structure.

The largest European slate quarries are in North Wales, though it occurs also on the Continent. In this country, slate is extensively worked in Maine, Vermont, New York, Pennsylvania, and in the Peach-Bottom district of northern Maryland. It is found in several other States.

Its color varies in different localities, from drab through different shades of green and red.

Though essentially a silicate of iron and alumina, slate often contains other ingredients which we may term "accidental," that seriously affect its durability. A specimen of ordinary slate analyzed by M. Maumené contained of silica 48.6 per cent; alumina 23.5; sesquioxide of iron 11.3; magnesia 1.6; potash 4.7; water 7.6. A Scotch slate contained of silica 50 per cent; alumina 27; sulphate and oxide of iron 11; magnesia 1; potash 4; water 7. Among the accidental ingredients are carbonates of lime and magnesia, and iron pyrites or sulphide of iron. All of these substances are injurious and increase the tendency of the slate to disintegrate or fall to pieces by the action of the weather. One specimen examined by the above author contained 53.5 per cent of carbonate of lime. It is needless to say that it had been condemned because it would not weather well. Acid liquids readily decompose carbonates, and roofing slate is particularly exposed to the action of sulphurous fumes from the chimneys. These settle on the roof, become oxidized, and combine with the lime, setting the carbonic anhydride free, while the sulphate of lime is washed away, and thus the slate is decomposed.

In regard to the pyrites, which is often visible as bright, brassy particles collected in parallel lines, it is oxidized by action of air and moisture, and the resulting sulphate is washed out by the rain, hence its presence is detrimental.

Another accidental factor having an influence on the durability, is the porosity. Those slates absorbing the most moisture will be more subjected to the disintegrating effects of atmospheric agencies, especially rain and frost, and will soonest be destroyed. Dry slate treated with water absorbs from two ten-thousandths to twenty-five ten-thousandths of its weight. The American slate has a density of about 2.80.

The methods employed in quarrying, and in fact many of the managers and workmen engaged in the slate industry in this country come from Wales. The pit is often worked to a great depth. In the slate regions visited by the author, the rock is dislodged by blasting, the holes being drilled by a steam diamond-drill, or the slabs are split off by a line of wedges. Seams usually occur which greatly facilitate the quarrying. The pieces of, say eight feet in length by two in

width and eighteen inches thick, are hoisted to the surface by the use of a tackle running on a stout guy-rope which extends to a lower opposite point of the pit. Occasionally pieces of more than three tons weight are hauled up. Slate one inch in thickness weighs about fourteen pounds to the square foot. The blocks, after being wet are separated into thinner slabs, and then skilled workmen split them by the use of thin iron wedges into plates of the required thickness. Others, paying special attention to the "ribbons" or lines that usually run diagonally across the pieces, cut them up into squares of convenient size. This latter operation may be performed by the use of a peculiar tool called a "sack" or "sax," or more expeditiously by the use of a pair of large spring shears run by foot power. Different sizes are cut from the same slab to economize the material. Roofing slate is sold by the "square" of 10x10=100 square feet.

This same material is being more extensively used than formerly in the manufacture of paving stone, steps, tables, billiard tables, blackboards, mantles, etc. In order to work it into the above forms, it is found most convenient to saw it by the use of a "gang" saw, the edges of which are set with black diamonds. These are soldered into the metal, and when the saw is drawn over the wet stone a groove is cut very rapidly. The slabs can afterwards be planed, the edges squared and the surface polished. Stone thus prepared, not polished, and an inch in thickness costs about thirty cents per square foot. It is a very durable material, and especially useful from the fact that it is so readily worked into any desired form.

UNIVERSITY OF KANSAS, December, 1883.

ST. LOUIS WHITE LEAD.

One of the leading industries of St. Louis at the present time is the manufacture of white lead. Of an estimated production of 80,000 tons for the current year in the United States, St. Louis is credited with 20,000 tons, a larger production than that of any other city. Even New York takes a second place, though it has made great pretentions as a producer of white lead.

The industry is represented here by four establishments, employing 600 hands and having an invested capital of $3,000,000. Including the production of red lead and linseed and castor oils, the value of the product is estimated to be $4,500,000 for the current year. Of the four works, two produce castor and linseed oils, one red lead direct from the pig, and one of the two making oils has lately entered upon the manufacture of pipe lead, and will soon add a sheet lead department. The production of pipe lead by this one works is not considered, however, in any of the above estimates; and properly the production of oils should have been excluded from the estimated value of the annual product, for the making of oil is in fact a separate business.

The growth of the industry has been remarkably regular and steady in the last few years, the annual increase in business having seldom fallen below 15 or

exceeded 20 per cent. The comparative nearness of the local works to the lead producing regions of this State and Illinois and those of Colorado gives the industry advantages which are not shared in by the white lead manufacturers of any other city in the Union. Cincinnati and Pittsburg, both farther away from supplies of blue lead, indirectly bear witness to the importance of these advantages, by the gradual decadence of their white lead industry. Latterly, however, the advantage of being near the lead fields of Illinois and Missouri is not so apparent as in former times, but a very small percentage of virgin lead being consumed at this time by manufacturers of white lead. Most, if not almost, the entire quantity of lead used by them is refined lead produced from bullion carrying silver by refining works at Kansas City, Omaha, Pueblo, and by the one large works here. The uncertainty of getting supplies promptly, and the impurities in the virgin lead, coupled with other causes, lead to the abandonment of it by manufacturers for the refined lead of Colorado and the far west, the supply and quality of which can be depended upon. Even in the great Joplin district in this State but a small part of the output is suitable for the manufacture of white lead, the old worked-out mines immediately around Joplin being the only producers of a proper lead. The lead of Short Creek and Galena production, while especially adapted to the manufacture of sheet lead and lead pipe, by reason of the presence of copper in, it is for this very reason unsuited to the making of white lead.

The export trade of St. Louis in white lead is quite large, but it should not be inferred from this that shipments are made to foreign countries, for the cheap product of England and continental Europe inhibits exports to markets outside the United States. But to all parts of the national territory shipments are made regularly, and the aggregate of exports from this market makes a very respectable showing. Below we give the exports for ten months in the current year from St. Louis:

	POUNDS.
January	2,815,324
February	2,854,741
March	3,282,557
April	2,918,231
May	3,279,054
June	3,222,407
July	3,271,102
August	3,421,088
September	3,268,364
October	2,574,286
Total	30,937,154

From this it will be seen that the average monthly exports in the current year have exceeded 3,000,000 pounds, from which it may be assumed that the record for the entire year will show a total exportation of something like 36,000,-

000 pounds. Taking the home consumption into consideration, which has been quite large this year, it will be seen that the estimated production of the local works (20,000 tons) is not far out of the way.—*Age of Steel.*

PRACTICAL ART SCHOOL FOR WOMEN.

The question of teaching women in America the Arts of Design has been solved by Mrs. Florence E. Cory, herself a practical designer. Mrs. Cory is a graduate of Cooper Union, and in 1877 taught in that Institute the first class in practical carpet designing ever established for women in this country. After leaving Cooper Union Mrs. Cory took a thorough course of instruction in practical design at the largest carpet factory in New York City. Afterward she visited a representative factory of nearly every art industry in the United States, studying in each the technicalities of the machinery and the practical requirements of design for these various industries, thus qualifying herself to be the best, as well as the first teacher in practical design for industrial purposes in America.

In 1881 Mrs. Cory established a School of Industrial Art for Women, having seventy-five pupils, at her residence, last year. She has now taken a large suit of rooms in the Grand Opera House, New York City, and proposes to establish free classes for women and girls in Industrial Design, the only requirements for an admission being a fair amount of intelligence, a taste and appreciation of the beautiful, and the need of such benefit, with the expectation of becoming self-supporting. Pupils have the privilege of selling their work made while under instruction, (several hundred dollars were so earned by the pupils of last year,) the only requirement being that one fourth the amount received for such work shall be retained towards a fund for an Art Library, samples, drawings, etc., needed by the school; also each pupil, at the end of the year, shall leave one drawing as the property of the school.

GUN-FLINTS, ARROWHEADS, ETC.

Articles occasionally appear in the periodicals of the day purporting to describe the methods of manufacturing the ancient arrowheads, knives, and other flint tools and weapons.

These accounts so far as I have seen are not only very indefinite, but often contradictory. As these implements must have been in common use on these western plains within the last half century, there should be many persons now living who have personal knowledge of the matter.

Again, it is but a few years since the old gun-lock flint gave place to the percussion cap. By whom, when and how were these gun-flints made?

I well remember they were very plenty and cheap (one cent each at retail,)

at almost every little trading place in the country; showing that they were easily and cheaply manufactured; but where or by whom?

If any of your readers can give any real light on this subject, it may please others besides A. L. C.

METEOROLOGY.

TORNADO MYSTERIES.

CAPT. SILAS BENT.

ST. LOUIS, Nov. 28, 1883.—Your article of to-day upon the "Tornado Mystery" is so suggestive, and discusses a theory which I am so heartily convinced is correct, that I venture to offer you a communication sent to the *Courier-Journal* of Louisville some twelve months ago.

"I have read with much interest Mr. G. W. Tinsley's theory as to the cause of the "sun spots" published in your issue of the 26th inst. I shall not undertake to discuss that theory, but will beg your indulgence for a few comments upon that point in Mr. T's article wherein he assumes that the sun is enveloped in a flame of fire.

This I know is the accepted theory of astronomers, but it has never been satisfactory to my mind as being possible in the due order of nature; for in that order, the operations of physical laws are uniform whether on the sun or on the earth. A flame of fire means combustion, and combustion means the consumption of fuel. So, notwithstanding astronomers say that the combustion of the sun is fed by invisible bodies falling into it from stellar space, yet when we reflect that each of the fixed stars of the universe is itself a sun, as large or larger than our own, and that they are all governed and sustained by the same laws, it is incredible that there should be floating through space sufficient matter to keep these myriads of suns in perpetual combustion, without diminution or extinction, and yet be invisible to our telescopes, particularly as the computations of these same astronomers show that our whole planetary system would not keep up the combustion of the sun for more than fifty or a hundred years if fed to it piecemeal.

Again, if the sun is a ball of fire and radiates its heat for the sustenance of its planets, then the earth alone is just at that fortunate distance from the sun which gives it the temperature that sustains life in beings organized as the inhabitants of the earth are, and which beings so organized could not exist on any other planets, owing to their necessarily different temperature arising from their varying distances from the sun.

This would make the earth the only habitable planet for beings of like or-

ganization and intelligence as ourselves; for, since man is made in the image of God, then no other beings outside of heaven can be superior to man; yet man would die of heat on Mercury and of cold on Saturn.

Furthermore, if the heat from the sun is heat radiated from a burning body, the nearer we approach the sun the hotter it would be: yet this is not found to be the case, for the higher one goes on a mountain or in a balloon the colder it gets, until, if a point beyond our atmosphere in stellar space could be reached, the temperature would be found 500 degrees or more below the freezing point.

But to meet these difficulties let us suppose that our sun, and all other suns are centers of electric power; or, great electric machines, which throw out electric rays that emit light but yield no heat, until heat is generated by the friction of those rays as they pass through the resisting medium of our atmosphere; and that the heat so generated is in proportion to that resistence as caused by the greater or less density and humidity of the atmosphere.

The revolution of the sun upon its axis and through its orbit maintaining its electric power and luminosity without requiring material substances for its fuse, would go on shining forever and with unvarying brilliancy.

All planets, then, having atmospheres may have temperatures the same as that of the earth, whether they be as near the sun as Mercury or as remote as Neptune.

This electric hypothesis is sustained by other familiar facts, such as the striking resemblance in color and appearance of our electric light with the sun light, and by the sympathetic disturbance of the magnetic needle upon the earth whenever eruptive disturbances occur in the atmosphere of the sun.

The earth being ninety odd millions of miles distant from the sun, and light traveling at the rate of nearly 12,000,000 miles a minute, it takes about eight minutes for the light of the sun to reach the earth.

Therefore when the astronomer observes through his telescope a disturbance in the atmosphere of the sun he knows that that disturbance has actually occurred some eight minutes before it became visible to his eye; but simultaneously with his seeing the disturbance, the observer by his side notes a perturbed deflection of the magnetic needle, showing conclusively that the subtle influence from the sun that has thus disturbed the needle has either been sped upon the wings of light from the sun to the earth or else be one and the self-same thing as the light and heat of the sun, which I believe it to be."—*Cor. Globe-Democrat.*

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

During the period embraced in this report, from November 20th to December 20th, we have had dry cool weather, but owing to the very large rainfall in former months the humidity has been much higher than the rainfall of the month

would warrant. Owing to the excessive humidity the sky has presented a peculiar appearance, especially in the morning and evening, before sunrise and after sunset. At these periods there has been a ruddy glow noticeable which often extended nearly to the zenith. The absorption of violet rays by water-vapor accounts for this, and for the same reason close observers have noticed that the Sun and other heavenly bodies presented a peculiar appearance. It does not appear to the writer that such phenomena are strange under the circumstances

The rainfall of the past year to date amounts to 39.68 inches distributed as follows: January, 0.50; February, 3.10; March, 4.81; April 1.60; May, 6.52; June, 7.05; July, 6.52; August, 4.17; September, 0.88; October, 6.14; November, 0.81; December, 1.58.

This is nearly one-third above the average at this place.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Nov. 20th to 30th.	Dec. 1st to 10th.	Dec. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min				
Max				
Min. and Max				
Range				
TRI-DAILY OBSERVATIONS.				
7 a. m.	32 2	33.9	24 3	30.1
2 p. m.	56.2	57.5	42.3	52.0
9 p. m.	36.6	40.6	27.7	35.0
Mean	41.7	41.2	31.4	39 0
RELATIVE HUMIDITY.				
7 a. m.	.92	.92	.98	.94
2 p. m.	.78	.72	.87	.79
9 p. m.	.91	.88	.93	.91
Mean	.89	.84	.94	.88
PRESSURE AS OBSERVED.				
7 a. m.	29.050	29.099	29.073	29.074
2 p. m.	29.034	29.131	29.210	29.125
9 p. m.	29.075	29.145	29 185	29.135
Mean	29.053	29 125	29.156	29.111
MILES PER HOUR OF WIND.				
7 a. m.	12.5	14.1	19.2	15.3
2 p. m.	21.2	17.9	14.6	17.9
9 p. m.	11.0	12.4	14.0	12.5
Total miles.	2688	2711	2516	7915
CLOUDING BY TENTHS.				
7 a. m.	3.9	4.11	6.3	4.8
2 p. m.	4.1	1.8	6.9	4.2
9 p. m.	1.6	2.5	3.6	2.6
RAIN.				
Inches.	0.11	0.28	1.30	1.68

BOOK NOTICES.

LEGENDS OF LE DETROIT: By Marie Caroline Watson Hamlin. 12mo., pp. 317. Thorndike Nourse, Detroit, 1884. For sale by M. H. Dickinson.

This book is made up of some thirty tales based upon old French customs and traditions handed down by the descendants of the pioneers of the City of the Straits, who originally brought them from their native land of Normandy. They are quaint and fantastic, and the writer has fairly entered into their spirit and given us an attractive and instructive book. A descendant herself from one of the old families, it was her good fortune to hear many of them from the lips of ancestors whose memories extended back into the previous century, and she has made it her laborious but loving task to gather together in lasting form, the legends they delivered to her. While doing this, however, she has verified the historical points by studies of the best authorities, such as Charlevoix, La Hontan, Lambert, Le Moyne, the Pontiac Manuscript, Morris' Diary, Cass', Trowbridge's and Roberts' Memoirs, etc.

Among the legends we note particularly The Baptism of Lake Sainte Claire, The Bloody Run—a legend of Pontiac's siege, LeLoup Garou, The Feast of St. Jean, The Cursed Village, Captain Jean, The Eve of Epiphany. These, as well as all the others, in varying degrees, awaken interest and excite our sympathies, and the descendants of the old French settlers of this Missouri border will find among them many concordant tales that will arouse old memories and recall the stories told to them in their childhood.

To these tales Mrs. Hamlin has appended Hon. James V. Campbell's "Legend of L' Anse Creuse," and a brief account of a number of the old families of Detroit.

The work of printer and binder is well done, as also the illustrations, which are the work of Miss Isabella Stewart.

THE WONDERS OF PLANT LIFE: By Sophie Bledsoe Herrick. 12mo., pp. 248. Illustrated. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson; $1.50.

Several of the chapters in this little book were first published in *Scribner's Monthly*, for instance, those upon The Beginnings of Life: Single-Celled Green Plants: Ferns: Physiology of Plants: The Microscope among the Flowers, and Insectivorous Plants. Those on Fungi and Lichens, Mosses, Corn and Its Congeners, and the Pitcher Plants are new. The whole, however, is more complete and the serial connection is more closely made out than before.

The tribute paid to the Microscope in the first chapter, is so just and eloquent that we cannot omit it: "The line of telescopic discovery, sweeping off into

infinite space, might well bring doubt and despair to the mind which contemplates that alone; but there is another line of discovery more beautiful, more wonderful still. * * * * * This little instrument, then, (the microscope) has wrought a noble work for God and truth in the world. Not only has it revealed to us many secrets which make life easier, which soften the pangs of disease and diminish the anguish of bereavement, but it has helped to silence the voice which was delivering its message of desolation to the world in denying the Fatherhood of God. Not only does it show us the marvelous precision of inorganic nature, and the delicate adjustments of chemical, physical, and vital forces of organic, but it brings us into the very ante-chamber of that court where life holds its mysterious sway, almost into the presence of the subtle vital force which baffles analysis and laughs synthesis to scorn."

The wonders of plant-life under the microscope are shown in every chapter and upon every page of the book, and while technicalities are avoided the explanations are clear and full. It is written in popular style, yet an amateur can find as much of precision and minuteness as is necessary for all his purposes, at the same time that he is attracted by the curious and interesting facts detailed. The chapter upon Insectivorous Plants in uncommonly interesting and cannot fail to give much information to most readers.

The volume is very handsomely prepared and the illustrations are excellent.

BOND AND FREE: By Grace Lintner. 12mo., pp. 288. C. B. Ingraham, Indianapolis, 1883. For sale by M. H. Dickinson.

This is a tale of the South involving an account of life in the Southern States during the existence of slavery. It is well and earnestly written, and doubtless contains much truth, but whether it is best to revive the scenes of those days, even for the alleged purpose of perpetuating history, is questionable, especially when those scenes are portrayed under the veil of fiction.

PLASTER AND PLASTERING: MORTARS AND CEMENTS: By Fred T. Hodgson. 12mo., pp. 108. Industrial Publication Co., New York; $1.00.

This is intended by the author to be a complete guide for the plasterer in the preparation of all kinds of plaster, stucco, Portland cement, hydraulic cements, lime of Tiel, Rosendale and other cements, with practical information on the chemistry, qualities and uses of the various kinds of limes and cements, together with rules for measuring, computing and estimating plaster and stucco work. To this is added an illustrated glossary of terms used in plastering and a list of some of the best works on mortars, cements and plastering.

Everything in this little work is practical and useful, and it will be found of value not only to the mechanic but to the property owner desiring to build or repair buildings.

ABORIGINAL AMERICAN AUTHORS: By Daniel G. Brinton, A. M., M. D. Octavo, pp. 63. Philadelphia, 1883; Boards $1.00.

This is a novel contribution to the history of literature, being an extended review of the literary efforts of the red race in their own tongues and in other languages—English, Latin and Spanish. The work is founded on an address presented to the Congress of Americanists at Copenhagen in 1883, and will be found of most decided interest to ethnologists, linguists and historians. Beginning with an exposition of the literary faculty in the native mind, Dr. Brinton divides his subject into narrative literature, didactic literature, oratorical literature, poetical literature and dramatic literature, giving under each head accounts of native authors and their works that are calculated to arouse the interest of the reader in the subject and in many instances excite his surprise at the ability, talent and versatility displayed. He refers especially to the literary efforts of the Esquimaux, the Delawares, the Iroquois, the Creeks and Cherokees, the Aztecs, the Maya tribes, the Peruvians, etc., and points out many marked instances of skilled narrative, oratorical and dramatic writing by natives of various nations and tribes.

Dr. Brinton, who has published and is now publishing several works upon kindred subjects viz.: the Maya Chronicles, the Iroquois Book of Rites, the Comedy Ballet of Gueguence, American Hero Myths, etc., aims in this work to engage the interest of scholarly men, learned societies, enlightened governments and liberal institutions and persons of the United States, particularly, in the collection, preservation and publication of such monuments of the Nation's literature. He should not plead in vain.

ROUND ABOUT RIO: By Frank D. Y. Carpenter. 8vo., pp. 415. Jansen, McClurg & Co., Chicago, 1884. For sale by M. H. Dickinson; $2.00.

To write a book of travels and combine in it accuracy of scientific observation and piquancy of description, and at the same time maintain in it a love story, is rather an unusual undertaking and one to be regarded as comprising some of the incompatibles; but all this has been done by Mr. Carpenter, who, likewise, throws in many dashes of sarcastic wit at the peculiar customs of the people he describes.

Mr. Carpenter held for several years the position of geographer of the Geological Survey of Brazil, and under these peculiarly favorable conditions he acquired the material which, returning to America, he has made the basis of his book. Valuable as is the work for its information, it owes still more to its literary treatment. The author's studies of Brazilian life and manners, and his method of presenting them, are unique, and his book occupies a place quite its own among works of travel. It has but little of dry narration and sober details of general information; and yet, with all its vivacity and variety, it is doubtful if there is anywhere to be found so good a picture of life and scenes in and about the great metropolis of the Southern Hemisphere—Rio de Janeiro. The obser-

vations and description of the the most interesting features of Brazilian flora and fauna are those of the trained naturalist, and are given with an imaginative faculty which selects only characteristic features, avoiding dry and wearisome details; while the thin veil of fiction thrown around the pictures adds a decided charm to the narrative.

No book, that we have seen lately, so well fills the *rolē* of a "traveler's companion" or a welcome relief to a tired brain.

A SYLVAN CITY, Illustrated: 12mo., pp. 508. Our Continent Publishing Co., Philadelphia: Fords, Howard & Hulbert, New York. For sale by M. H. Dickinson; $2.00.

This is a very interesting account of the quaint and picturesque features of the city of Philadelphia, both ancient and modern. It is exceedingly well illustrated by well known artists, and the various chapters are the productions of Helen Campbell, Louise Stockton, Elizabeth Robins, Edwin A. Barber, Eliza S. Turner and Frank Willing Leach. The first chapter is devoted, naturally, to William Penn, whose portrait serves as a frontispiece in the unusual garb of a soldier, which he actually was for a short time and which he remained so far as fighting the fight of faith and principle all his life. Fourteen other chapters follow, giving full descriptions of The City of a Dream; Old St. Joseph's; The Old Philadelphia Library; The Post-Office; The Public Schools; The Bettering House and Other Charities; Steven Girard, etc.

The subjects are all well chosen, and the illustrations, numbering nearly two hundred, are exceptionally good. To all Philadelphians and their descendants, this book will be a welcome visitor, as well as to all Americans who take an interest in the peculiarities of the early settlers of the country. The work of the bookmakers has been handsomely done in every respect and the volume presents an exceedingly tasteful appearance.

ART AND LITERATURE: Edited by Titus Munson Coan. 16mo., pp. 194. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson; paper 25c., cloth 60c.

This is No. VI Vol. I of the Topics of the Time series, to which we have referred so often, and comprises the following articles: The Philosophy of the Beautiful, by Prof. John Stuart Blackie; Hellenism in South Kensington, a dialogue between Plato and Landor, by H. D. Traill; The Beginning of Art, by Stanley Lane-Pool; The Ancient, Mediæval and Modern Stage; The Impressionists, by Frederick Wadmore; Wagner and Wagnerism, by Edmund Gurney: all typical and able articles, furnished at a mere nominal rate.

This series can be subscribed for by the year at $6.00 in cloth, or $2.50 in paper.

THE COTTAGE KITCHEN: By Marion Harland. 12mo., pp. 276. Chas. Scribner's Sons, New York, 1883. For sale by M. H. Dickinson; $1.00.

Marion Harland's "Common Sense" books have gained her a wide celebrity among housekeepers, and this new one will in no respect decrease it. It comprises the whole list of cookeries and cookables and seems to combine hygiene with elegance and economy. No lady can have any tolerable excuse nowadays for poor, unwholesome diet and bad cooking.

ANTI-TOBACCO: By Abiel Abbot Livermore. 16mo., pp. 117. Roberts Bros., Boston, 1883. For sale by M. H. Dickinson; cloth 50c.

This essay of Mr. Livermore's is the substance of an able and comprehensive address delivered before the Meadville Temperance Union, and is accompanied by a lecture on Tobacco and Its Effects by Rev. Russell Lant Carpenter, and an article on The Use of Tobacco by G. F. Witter, M. D.; the whole making up as powerful an argument against the use of "the weed" as it is possible to conceive. It should be widely distributed by hygienic and temperance societies everywhere.

OTHER PUBLICATIONS RECEIVED.

Third Annual Report of the United States Geological Survey for 1881-2, J. W. Powell, Director, pp. 564. U. S. Fish Commission, Report of Commissioner for 1880, Spencer F. Baird, Commissioner, pp. 1060, Illustrated. Calendar of American History, 1884; compiled by Delia W. Lyman, G. P. Putnam's Sons. Mineral Resources of U. S., 1882-3, Albert Williams, Jr., pp. 813. Report of Commissioner of Education for 1881, pp. 840, Gen. John Eaton, Commissioner. Problems of Inter-oceanic Communication by way of American Isthmus, by Lieut. John T. Sullivan, U. S. N. quarto, pp. 219, with maps. Proceedings of Missouri Press Association, 1883, Secretaries Chas. T. McFarland and Jos. H. Turner, pp. 68. *The Library Journal*, Vol. 8 No. 11, Publisher T. Leypoldt, 31 and 32 Park Row, New York, monthly, $4.00. *The Homiletic Monthly*, Vol. 8 No 3, I. K. Funk, D. D., Editor, pp. 59, $2.50. *The English Illustrated Magazine*, Vol. — No. 3, Macmillan & Co., N. Y., $2.50. *Humboldt Library*, Money and Mechanism of Exchange, by W. Stanley Jevons, Part I, pp. 94, 15 cents. *The Art Interchange*, Vol. 11, No. 12, semi-monthly, $3.00. Time-Keeping in London, by Edmund A. Engler; D. Appleton & Co. N. Y. Christmas Literary Bulletin of Houghton, Mifflin & Co. Third Annual Report of Kansas City Provident Association for 1883. *The Irving Library*, 1883, Vol. 1 No. 1, weekly, $25 a year; John B. Alden, Publisher, N. Y. *Industrial News*, Vol. 4 No. 11, quarto, pp. 20, published monthly by Inventor's Institute, N. Y., $1.50. *Travel*, Vol. 1 Nos. 4 and 5, monthly, published by American Exchange in Europe, 162 Broadway, N. Y.. 50 cents. Notes on Literature of Explosives, Chas. E. Munroe, U.

S. N. A., pp. 21. Sixteenth Annual Report of State Board of Agriculture, pp. 179, Secretary J. W. Sanborn. First Annual Report of Associated Charities of Cambridge, pp. 27, Secretary Wm. F. Piper. Seventy-Second Annual Catalogue of Officers and Students of Hamilton College, 1883–4, pp. 80. Chart and Supplement to Pilot Chart of North Atlantic for December, pp. 11, Commander J. R Bartlett, U. S. N. *Johns Hopkins University Circulars*, Vol. 3 No. 27, 10 cents, pp. 27. *The Pansy*, Mrs. G. R. Alden, Publishers, D. Lothrop & Co., Illustrated, pp. 40. *Scientific Proceedings of Ohio Mechanics Institute*, Robert B. Warder, Editor, Vol. 2 No. 3, published quarterly, $1.00. *Scandinavia*, published 20 N. Clark St., Chicago, Ill., monthly, $2 00. The Childhood of Religion, by Edward Clodd, F. R. A. S., No. 47, 15 cents. Local Government and Free Schools in S. C., by B. James Ramage, A. B., published by Johns Hopkins University. *Bulletin of Essex Institute*, Vol. 14 No. 1—12, pp. 59.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

AUTOMATIC CUT-OUT FOR TELEPHONES.—The object of a device recently patented by Messrs. C. D. Wright and C. A. Fisher, of Petersburg, Ill., is to provide an attachment for telephone instruments so improved that all the telephones on the line, between any two given instruments of this nature, may automatically be thrown out of circuit, thereby greatly shortening the same and decreasing the resistance to the current in a degree corresponding to the number of instruments cut out.

A mechanism of clock-work is released by means of an electro-magnet, when the current passes, and a lever resting upon a peculiarly notched wheel of the mechanism, is virtually brought in contact with one of the binding-posts, through the medium of a spring. The current is thus short-circuited, passing through the instrument without passing through the transmitter and receiver.

The necessity of removing a telephone, should a subscriber from any cause not desire to operate it for any length of time, and the considerable expense of putting one up again in the same room, for another subscriber, seems to be cheaply obviated in a very simple and efficient manner by the device.

RARE FISHES

A large number of rare and curious specimens of deep sea fishes have just been received by Prof. Gill, of the Smithsonian Institution. They were caught

by the crew of the Fish Commission steamer Albatross, the latter having just returned from an exploring expedition in mid-ocean. The Albatross was absent two months, during which time fish were captured representing thirty new species, twenty new genera, and three families. The British exploring steamer Challenger during a three years' cruise only secured specimens representing fourteen new genera. The wonderful success of the Albatross is therefore emphasized by scientific men in this city. The fish are caught by means of a dredge or net, which is sunk very often to a depth of 3,000 fathoms.

Among the strange denizens of the deep caught during the cruise are the following: The *Anchenichthy*, or fish with a neck. This specimen resembles an eel, has a well formed neck, and was caught at a great depth. The *Gastrostonius Bairdii* (named after Prof. Baird). This odd looking fish was described in the *Popular Science Monthly* as "the wonder of the deep sea." It is a variety of the devil fish. The jaw bones are seven times as long as the cranium, and are attached to wings resembling fine black silk, which come together, forming a broad pouch. The fish swims about with its pouch open, acting in the capacity of a seine. Small fish are caught in the latter, and transferred to the mouth by means of suction. The "Baird fish" resembles a leather-wing bat in some particulars, and has a long and scaly tail. The *Cryptopsaras*, or "angler with concealed rod," is a most remarkable specimen. It has a very large mouth, and extending from a concealed rod on the back is a baited line, which floats above the body. Small fish nibble at the line, and are captured by the "angler." The bait is a ball of jelly-like matter, which is so sensitive that instant notice is given when a fish touches it. Another member of the "angler" family is perfectly blind. It is known as the *Typlopisaras*, or "blind angler." This remarkable fish fisher was never heard of until the recent cruise of the Albatross, and it is said to inhabit the sea 2,000 fathoms below the surface. The *Hypercharistus Tanneri*, or fish with upper pectoral rays or finger separate, is a queer-shaped and vicious little fish. It inhabits deep water and is named after Capt. Tanner, of the Albatross, whose hand the little creature tried to bite when landed on the deck of the steamer with the deep sea seine. It is jet black, and has teeth like a circular saw. The *Neurichthyids*, or snipe eel, is a genuine curiosity. Its body resembles that of an ordinary eel, while the head is a fac simile of that of the common marsh snipe which abounds in Maryland and Virginia. The tape fish is another interesting fish. It is of the size and thickness of ordinary tape, and when in the water is perfectly transparent and can only be seen by its little red eyes.

There are several other remarkable specimens. They are kept in jars of alcohol in Prof. Gill's office, and will appear in the illustrated annual reports as fish discovered thousands of fathoms below the surface of the Atlantic by the United States Fish Commission. They will also probably be placed upon exhibition in the national museum or Smithsonian.—*National Republican.*

EDITORIAL NOTES.

THE mortality among scientists recently, seems to have greatly exceeded the average rate. We note the following deaths within the past three or four months: Victor Alexandre Puiseux, the French Astronomer; Dr. Conrad Bursian, a distinguished German Philologist; M. Joseph Antoine Plateau, an eminent Physicist, of Ghent; Prof. Oswald Heer, Palæontologist and Botanist, of Switzerland; all in September; Prof. J. Lawrence Smith, Chemist, of Louisville, Ky.; M. Alfred Niaudet, of France, Electrician; Prof. M. F. S. Cloez, Professor of Physics in the school of Fine Arts; Mr. Louis Bregnet, of France, distinguished as an Electrician; all in October; Prof. C. W. Siemens, of London, noted as an Engineer and Electrician, and Dr. John Le Conte, one of our most eminent American Entomologists, both in November; Prof. E. A. Sophocles, of Harvard College, in December.

THE water-works at Rich Hill, Mo., just completed, have been tested by the city authorities and found satisfactory, having thrown four fire streams more than 100 feet high. There are two Blake Duplex engines, each of one million gallons capacity in twenty-four hours, and two boilers for same.

DR. ENGELMAN recently read a meteorological paper before the St. Louis Academy of Science giving the mean temperature of the summers, winters and mean annual temperature for the past forty-eight years, the same being accompanied by a chart illustrative of the subject. It appears that the mean winter temperature during this time has averaged 33.4; the mean summer temperature, 76.8, and the mean annual temperature, 55.4. The Doctor stated in his paper that he had hoped to have discovered some law of the variation of the mean temperature from year to year, but in this respect he had been disappointed, as the variations were irregular and without any law. The variations of the mean temperature of winter were greater than of the summer. One remarkable thing was the return of the periods of six or seven years when the mean temperature was nearly normal. The observations tended to show that there was little data for predicting the temperature or prognosticating the weather. The coldest winters were 1856, 1857, 1872, 1873, 1881. The warmest summers were 1838, 1850, 1854, 1874 and 1881.

THE Observatory of Washington University has just received from Mr. George Partridge a present of a very valuable and costly meridian transit instrument, with all the appliances for accuracy and convenience of work. The instrument was made by Fauth & Co., of Washington, the best makers of such instruments in this country. The telescope has an aperture of three inches and a focal length of over three feet. The axis carries two 12-in circles, one reading to ten seconds, the other to single minutes. The fine circle carries the latitude level so the instrument can be used as a zenith telescope. A very delicate striding level serves to determine the level of the axis. The instrument is mounted upon a heavy iron base which is placed in a solid stone pier and is furnished with reversing apparatus and mercurial basin and with delicate adjustments in level and azimuth. The bearing surfaces of the pivots are of agate. The instrument is one of the largest of its kind in the West, and is in every way a credit to the University and to the donor, Mr. Partridge. Its cost in the shop was $1,000.

A COMPLETE set of the philosophical transactions of the Royal Society of England, has been presented to the Rose Polytechnic Institute, Terre Haute, Indiana, by the President of its Board of Trustees. There are but three or four such sets in this country.

THE recently discovered comet of 1812, can be seen clearly defined in the northwest sky without the aid of a glass. The observatory people reported some time ago that it would scarcely be seen with the naked eye until the last of the month, but it is now plainly visible, being equal in brightness to a star of the fifth magnitude, or as bright as Halcyone, the largest star in the Pleiades. The wanderer is near the bright star of Vega or Alpha Lyræ in the constellation of the Harp, and about an hour behind it, right ascension. By January 15th the stranger will be wholly visible to the unaided vision. The tail of this comet in 1812 swept athwart the sky nearly 90°, but it has been very much shorn of its glory and will not present by any means the beautiful spectacle of the comet of 1881.

THE President has appointed a board of officers of the army and navy to consider the question of sending an expedition to the relief of Lieut. Greely and party, and to recommend to the Secretaries of War and Navy, jointly, what steps the board deem advisable be taken for the equipment and transportation of a relief expedition, and suggest such plan as to its control and organization of its personnel, as seems best adapted to a complish its purpose. The board is composed of the following officers: Brigadier-General W. B. Hazen, Chief Signal Officer, United States Army; Capt. James W. Greer, United States Navy; Lieutenant-Commander B. H. McCulla, United States Navy, and Captain George W. Davis, 14th Infantry, United States Army. The board met in Washington the 20th ult.

IN Washington City the telephone company has been required to run its wires underground, and it is expected that within a short time the various telegraph companies will also do so, as the Postal Teleraph Company was not permitted to come within the city until after it had agreed to such conditions. The district authorities say that the telephonic communications are much more distinct than before, and note with satisfaction the absence of the buzzing sound so annoying formerly.

THE latest railroad scheme is that of a line across America, Asia and Europe, by way of Alaska, Siberia and Russia; the plan involving the bridging of or tunneling under Behrings straits. De Lesseps might turn his attention to it, after he performs the trifling jobs now in hand.

THE publisher of the REVIEW has for sale, very low, a large, fine, new parlor organ, suitable also for college chapel, lecture room, or church. It is one of the very best styles, and can be had at a decided bargain.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *Art Interchange* for 1884 is a thoroughly practical, intelligible, inexpensive art journal. It is devoted to decorative, household, and pictorial art, home art work, literary and art news, and notes and queries. It is handsomely illustrated with leading examples of American art, besides giving full-size working patterns of standard decorative designs, for the use of amateurs and professional art students, and workers in ceramics, art needlework, and the kindred minor decorative arts.

Instructions and suggestions in art needlework, painting on textiles, wood, china, and glass; wood-carving, mural decoration, art-furnishing, modeling, etching, drawn work, sketching on linen, tapestry painting, brass hammering, etc.

Notes and Queries give expert advice, supplying readers with information that it would be difficult to obtain in any other manner.

Full-Page color studies by such masters of color as Messrs. Francis Lathrop, H. M. Lawrence, Walter Satterlee, Associated Artists, Misses Rosina Emmet, Dora Wheeler, Caroline Townsend, and such authorities on decoration as the Boston, Philadelphia, and New York Decorative Art Societies, appear with every other issue. $3.00 per annum.

THE *Popular Science Monthly*, now in its twenty-fourth volume, has always maintained a high standing among readers of all classes. Its contents for January show that this standard is to be maintained as fully for 1884: The Classical Question in Germany, by E. J. James, Ph. D. Early Colonists of the Swiss Lakes, by F. A. Forel, (illustrated). The Morality of Happiness, by Thomas Foster. Female Education from a Medical Point of View, II., by T. S. Clouston, M. D. The Control of Circumstances, by William A. Eddy. Religious Retrospect and Prospect, by Herbert Spencer. The Iguanodon, (illustrated). Defective Eye-Sight, by Samuel York At Lee. The Chemistry of Cookery, by W. Mattieu Williams. Catching Cold, by C. E. Page, M. D. The Source of Muscular Energy, by J. M. Stillman, Ph. B. Idiosyncrasy, by Professor Grant Allen. Etienne Geoffroy Saint-Hilaire, (with portrait). Correspondence. Editor's Table. Literary Notices. Popular Miscellany. Notes.

THE *North American Review* for January presents the opposite sides of the question of "Ecclesiastical Control in Utah," set forth by two representative men: President John Taylor, the official head of the Mormon Church, and the Hon. Eli H. Murray, Governor of the Territory of Utah. Senator John I. Mitchell writes of the "Tribulations of the American Dollar," insisting that it is our imperative duty to-day to settle the question, whether we shall have dollars of unequal commercial value in circulation. In an article entitled "Theological Re-Adjustments" the Rev. Dr. J. H. Rylance insists upon the necessity of eliminating from the formularies of belief and from the current teachings of the churches, all doctrines and all statements of supposed facts which have been discredited by the advance of energetical scholarship, and by the progress of natural science. Senator Henry W. Blair, taking for his theme "Alcohol in Politics," advocates the submission to the people of an amendment to the Constitution prohibiting the manufacture, sale and importation of intoxicating liquors. "Evils Incident to Immigration," by Edward Self, is a forcible statement of the mischiefs wrought by the importation into our social and political life of an enormous and continual contingent from the lowest stratum of the population of Europe. Finally, the subject of "Bribery by Railway Passes" is discussed by Charles Aldrich and Judge N. M. Hubbard. Every one will read Gail Hamilton's second chapter of "The Day of Judgment."

THE December (Christmas) *Magazine of American History* is one of the most attractive issues of this excellent periodical that has yet appeared. It contains four historical Essays on Christmas and its observances in various parts of early America and among different nationalities, by John Esten Cooke, Norman McF. Walker of New Orleans, John Reade, F. R. S. C., of Montreal, and Mrs. Lamb, Editor of the Magazine. Then comes an article by the learned and scholarly Horatio Hale, M. A., "A Huron Historical Legion"; an exceptionally interesting sketch of "Colonel David Crockett, of Tennessee," by General Marcus J. Wright, of Washington; and a paper which will be widely studied by specialists and antiquarians.—"Quivira, A Suggestion"—by Dr. Cyrus Thomas. The other departments—Notes, Queries, Replies, Societies, and Book Notices—are, as usual, overflowing with good things. This Magazine is deservedly recognized in every part of the country as one of the best historical publications ever offered to the public.

PROFESSORS ORMOND STONE and Wm. M. Thornton, of the University of Virginia, announce a new mathematical journal as a successor to the *Analyst*, to be called the *Annals of Mathematics*. It is to be a bi-monthly, quarto in size, and to comprise at least twenty-four pages. It will commence February 1884, at $2.00 per annum. It is designed to be a medium of communication between teachers and students of mathematics, and the standing of its editors is a guarantee of its own high standing among collegiate journals.

Harper's Magazine for January is a worthy sequel to the brilliant Christmas Number of that periodical, as the following table of contents shows:

Portrait of John G. Whittier. The Quaker Poet.—Harriett Prescott Spofford, with ten illustrations, by Harry Fenn. At Mentone, I.—Constance Fenimore Woolson, with sixteen illustrations. The Old Packet and Clipper Service, with fourteen illustrations, G W. Sheldon. Ensnared, A Poem —Maurice Thompson. The Birth of a Nation.—T. W. Higginson, with six illustrations. James Buchannan.—William C. Prime, with Portrait. What was Seen by Juan Valdez in Saltillo, A Story.—Thomas A Janvier. Judith Shakespeare, A Novel, I.—William Black, with two illustrations by Abbey. Hidden History.—Rose Hawthorn Lathrop. Nature's Serial Story, I.—E. P. Roe, with five illustrations. City Athletics.—H. C. Bunner. Cassy's Christmas-box, A Story.—A Working Girl. Editor's Easy Chair. Editor's Literary Record. Editor's Historical Record. Editor's Drawer.

THE next issue, now due, of the unique *Library of Aboriginal American Literature* edited by Dr. D. G. Brinton, Philadelphia, will be "The Comedy of Gueguence," a play written and acted by the natives of Nicaragua. It dates from the 17th century, and is written in a curious dialect, half Aztec and half Spanish.

THE *Atlantic Monthly* for 1884. The conductors of the *Atlantic Mouthly* indicate herewith a few of the noteworthy feature for 1884, and need not assure its readers that it will continue, as it has been beyond question, the foremost of American magazines, in all features and varieties of literary excellence. Mr. Crawford's serial story "A Romance Singer," will run through the first six numbers of the volume for 1884 This story has attracted marked attention by its vigor and freshness. Oliver Wendell Holmes will write exclusively for the *Atlantic* during 1884. The mere announcement of frequent contributions by him is more welcome than almost any other announcement could be. Dr. Weir Mitchell. has written for the *Atlantic* a striking serial story, entitled "In War Time." This will begin in January. Henry James will contribute several short stories and sketches of Continental travel. W. D. Howells will furnish several papers of European travel. Charles Dudley Warner will contribute Essays on literary and social topics. The Contributors' Club will continue to be one of the most agreeable features of the *Atlantic*. New books receive more attention in the *Atlantic* than in any other magazine in the English language. Terms: $4.00 a year, in advance, postage free. With a superb life-size portrait of Hawthorne (new), Emerson, Longfellow, Bryant, Whittier, Holmes, or Lowell, $5 00. Each additional portrait $1.00 Remittances should be made by money order, draft or registered letter to Houghton, Mifflin & Co., 4 Park Street, Boston, Mass.

THE title of *New Remedies* has been changed to the *American Druggist.* It has also been changed in form, enlarged, and the number of pages increased. It is still edited by Dr. Frederick A. Castle, and Chas. Rice, Ph. D. We regard it the best publication of the kind in the country. It is published by Wm. Wood & Co., New York, at $1.00 per annum.

THE meeting of the Kansas City Academy of Science, for December, was held on the evening of Friday, the 21st. The paper of Dr. R. W. Brown, upon "Memory," was well written, admirably illustrated by means of original drawings and demonstrations from the human brain, and well received by his audience.

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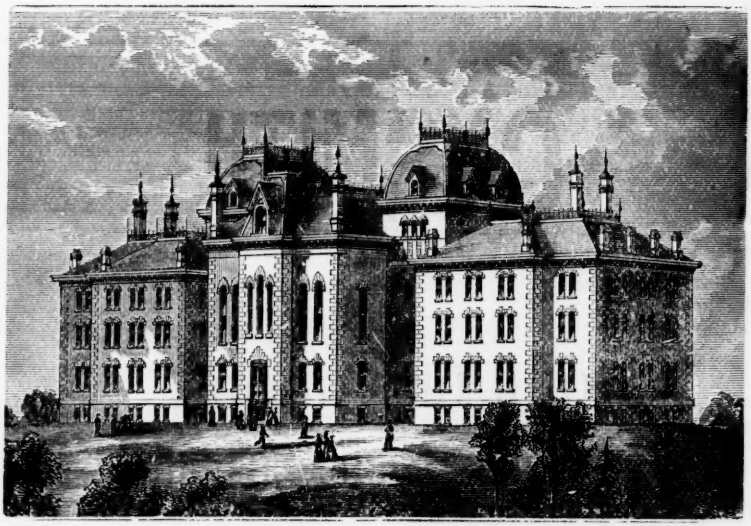

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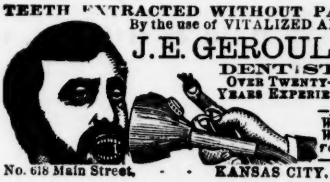

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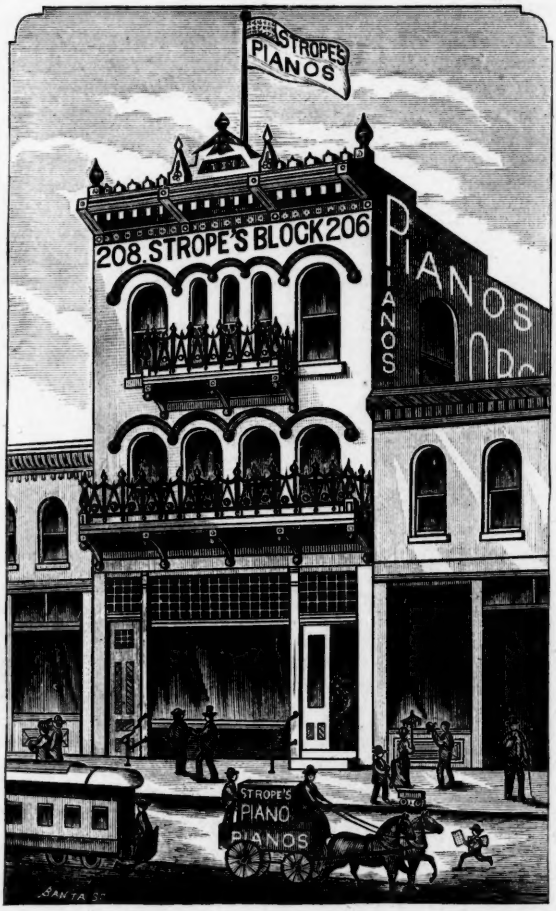

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